Novon

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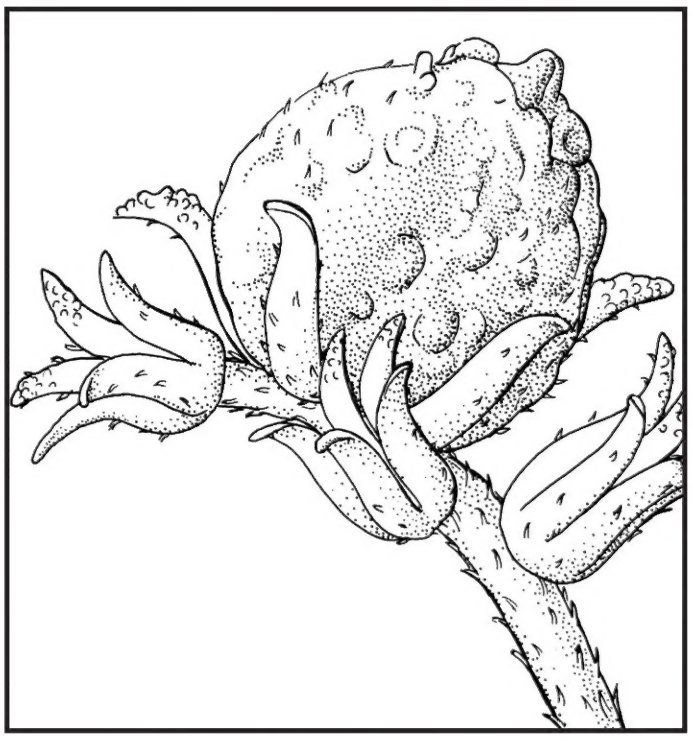

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Novon, a Journal for Botanical Nomenclature from the Missouri Botanical Garden

The mission of the Missouri Botanical Garden is to discover and share knowledge about plants and their environment, in order to preserve and enrich life.

Novon is a peer-reviewed botanical journal whose purpose is to publish articles establishing new nomenclature, including new taxa and new names, for vascular plants and bryophytes. Short papers typifying existing names may also be accepted. Lengthy revisions that primarily describe and discuss known species, while publishing nova incidentally, are not appropriate for *Novon*. Articles may be written in English or Spanish.

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Editorial

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I am honored to succeed Dr. Victoria Hollowell as Editor-in-Chief of *Novon*. The special purpose of *Novon* is to publish new botanical nomenclature, including new taxa and new names in vascular plants and bryophytes; short papers typifying existing names are also published. The journal's authors and readers are distributed worldwide, but the Neotropics are a particular focus. Of 65 papers published in the previous volume, the primary geographic region of the taxa dealt with was South America in 28, Central America in 13, East Asia in nine, southern Asia in four, Central Asia to the Middle East in four, and Europe, Africa, Malesia to the Pacific, and North America each in two papers. For this reason, we have a tradition of accepting manuscripts either in English or in Spanish, and encourage authors writing in English to supply a Spanish abstract when taxa native to Spanish-speaking nations are described.

It has been plausibly estimated that 10% to 20% of flowering plant species are as yet unknown to science (Joppa et al., 2011). Pimm and Joppa (2015) suggest that these may total as many as 50,000 unknown species, most of which remain unknown because of their limited range or rarity, meaning that they are at risk of extinction. Prompt publication of taxonomic novelties serves the important function of making government agencies, conservation groups, land managers, and other stakeholders aware of the existence, distribution, and habitat requirements of such taxa so that efforts can be made to preserve them. Likewise, the publication of new names and combinations facilitates the stabilization of nomenclature and the establishment of maximally useful taxonomic classifications.

Taxonomic research is increasingly undervalued in recent years, in part due to the fashion of quantifying research value through impact metrics that count the number of scientific literature citations that individual articles, or contemporaneous articles published in the same journal, generate within two years of their publication. These measures are especially flawed for assessment of taxonomic literature because many taxonomic journals are not even included in the system (e.g., Krell, 2009). McDade et al. (2011) point out that taxonomic treatments of understudied groups, which rationally should be considered most urgent, have lower "impact" because few, if any, specialist colleagues exist who might cite them within two years. These objections are all legitimate, and the suggestion that in taxonomy the longevity of a work is more meaningful than its short-term citation count (e.g., Valdecasas et al., 2000; McDade et al., 2001) is certainly correct.

Beyond that, the publication of new taxa and names is an essential prerequisite for many types of work that do not involve citations in peer-reviewed journals. For example, new species will later appear in floras, checklists, and revisions. As McDade et al. (2011) note, the traditional abbreviated style by which protologues are referenced in revisions is not recognized as a "citation," while books, such as floras (which usually supply only the authorial abbreviation in any case), are not considered to be acceptable sources of citations at all. Those works will be used for decades to identify specimens in multiple herbaria, compile lists of species of conservation concern, supply information on species distribution and rarity to land managers and regulatory agencies, and perhaps inform the delimitation of new protected areas—none of which will generate a single citation in a scientific journal. Additionally, journal articles dealing with systematics, ecology, phytochemistry, and other biological sciences would be unable to put meaningful names

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on taxa without the direct or indirect use of such works.

Thus, if the purpose of producing a journal publication is to be useful to other human beings, rather than to be cited in other journal publications, taxonomic publications are of high average value. As our field is the very foundation of biological research, our need is not to add value to the publication of new taxa, but to ensure that others are aware of the great value that already exists therein.

For *Novon*'s editorial staff, recognition of the importance of our authors' work creates two potentially conflicting goals: to ensure both that their valuable manuscripts are published expeditiously, and that their published papers are of the best possible quality. Missouri Botanical Garden Press has a tradition of meticulous editing that we will make every effort to maintain, while redoubling our efforts to make the publication process as efficient as possible. To streamline manuscript reviewing, we are adopting an online submissions management system (<www.editorialmanager.com/novon>) and have recruited an expanded panel of distinguished associate editors, whose willingness to serve in that role is greatly appreciated. Both the journal and manuscript authors benefit from the voluntary service of many dozens of peer reviewers. We are grateful to our reviewers for their contributions, and hope that those who value *Novon* will support it by accepting future invitations to review manuscripts.

Finally, for those with new names and new taxa to publish: this journal will be what you make of it. Within the limitations imposed by our mission statement, the scope of *Novon* depends upon the taxonomic and geographic interests of our authors. I welcome all plant taxonomists to choose *Novon* as a venue to share their work with the world.

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Draba ucuncha and *D. xylopoda* (Brassicaceae), Two New Peruvian Species from La Libertad

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Abstract. The new species *Draba ucuncha* Al-Shehbaz and *D. xylopoda* Al-Shehbaz are described and illustrated, and their relationships to closest South American species are discussed. Each is known from a couple of localities in the Department La Libertad, and their IUCN status is determined. An estimation of the New World species of *Draba* L. is given.

Key words: Brassicaceae, Cruciferae, *Draba*, La Libertad, Peru.

Draba L. is the largest genus in the family Brassicaceae (Cruciferae), with a previous estimation of 390 species (Al-Shehbaz, 2012a). However, 15 species have been added in the past four years (Al-Shehbaz & Mulligan, 2013; Al-Shehbaz, 2013, 2015, 2016, this contribution; Al-Shehbaz et al., 2014). As currently understood, *Draba* is represented in the New World by 203 species, of which 78 are restricted to South America and 125 are native to North America, including only five that are endemic to Mexico and Central America (Al-Shehbaz et al., 2010; author's compilation). The Eurasian *D. nemorosa* L. and *D. verna* L. are well established in North America, and the latter species is also naturalized in Argentina and Chile (Al-Shehbaz, 2012b).

Extensive molecular phylogenetic studies (Koch & Al-Shehbaz, 2002; Jordon-Thaden et al., 2010, 2013) have minimally altered the limits of *Draba*, and only nine species have recently been removed to three previously synonymized genera (Al-Shehbaz, 2012a). These include the North American *Abdra* Greene (two spp.), European *Drabella* (DC.) Fourr. (one sp.), and North and South American *Tomostima* Raf. (four and two spp., respectively).

During work on a synopsis of *Draba* for the New World, which is part of a worldwide treatment of the genus for the World Flora Online, I had the chance to examine many recently collected Peruvian Brassicaceae. They included many novelties in *Draba*, of which some require further collections, but the following two are complete enough to allow their recognition at the present.

1. Draba ucuncha Al-Shehbaz, sp. nov. TYPE: Peru. La Libertad: Bolívar, Ucuncha, SW side of Cerro Fila de Andonsa, sharp windswept karst, 07°07′14″S, 77°49′23″W, 3900 m, 14 Nov. 2013, *R. W. Bussmann, N. Paniagua Zambrana, C. Vega Ocaña & C. Téllez 18384* (holotype, MO-6688256; isotypes, HAO, GH, K). Figure 1.

Diagnosis. This novelty differs from the related *Draba brackenridgei* A. Gray by having noncanescent (vs. canescent) leaves abaxially pubescent with rigid, simple and 2-rayed forked trichomes (vs. soft stellate trichomes), petals 1.8–2.2 mm (vs. [2.5–]2.8–4[–4.5] mm), styles 0.07–0.15 (vs. 0.3–0.6) mm, and fruit sparsely puberulent along valve margins (vs. glabrous or uniformly pubescent).

Herbs perennial, caespitose, scapose; caudex with few, loose branches, slender, covered with persistent petiole remains of previous seasons. Stems 2–4.5 cm, erect to ascending, 1 from a rosette, herbaceous, leafless, pilose throughout with simple and stalked Y-shaped, and fewer 3-rayed and cruciform trichomes 0.05–0.4 mm. Basal leaves rosulate, persistent, not imbricate; petiole obsolete or 1–3 mm, persistent, stramineous, not flattened, glabrous, not ciliate; leaf blade oblanceolate to narrowly obovate, 4–8(–10) × 1.5–3(–4) mm, both surfaces pubescent with subappressed, rigid, simple trichomes 0.5–0.9 mm, these mixed abaxially with stalked, 2-rayed trichomes, base cuneate, margin entire or rarely 1-toothed on each side, not ciliate, apex obtuse; midvein obscure abaxially; cauline leaves of flowering stems absent. Racemes ebracteate, 8- to 15-flowered, corymbose, elongated slightly in fruit; rachis pubescent as stem, straight; lowermost fruiting pedicels divaricate, straight, 2.5–4 mm, glabrous adaxially, pubescent abaxially with simple and fewer 2-rayed trichomes. Flower sepals green, oblong, 1.5–1.7 mm, erect, caducous, sparsely pilose with simple and fewer 2-rayed trichomes, base not saccate; petals white, narrowly oblanceolate, 1.8–2.2 × 0.4–0.5 mm, caducous, apex obtuse; claw undifferentiated from blade; filaments white, 1.5–1.7 mm, slender at base; anthers ovate, ca. 0.2 mm, obtuse at apex; nectar glands confluent, subtending bases of all stamens;

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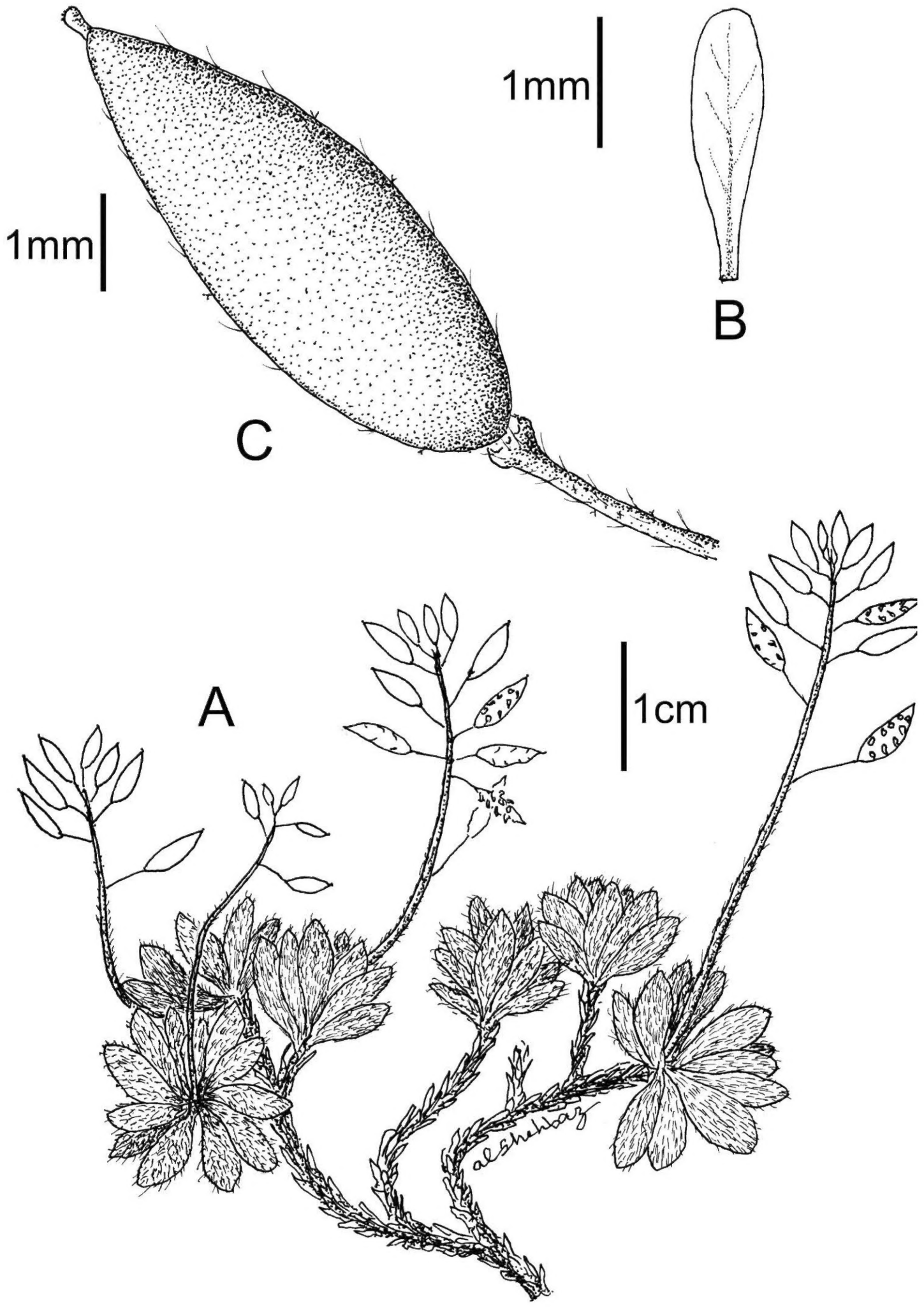

Figure 1. *Draba ucuncha* Al-Shehbaz. —A. Plant. —B. Petal. —C. Fruit and fruiting pedicels, abaxial surfaces. Drawn by Al-Shehbaz from the holotype *R. Bussmann et al. 18384* (MO).

ovules 20 to 30 per ovary. Fruit silicles or short siliques, oblong, 3.6–6 × 1.5–2 mm, slightly flattened, neither inflated nor twisted, sessile; valves sparsely puberulent at margin with simple and 2-rayed trichomes to 0.1 mm, with an obscure midvein, obtuse at apex and base; style 0.07–0.15 mm; stigma entire. Seeds light brown, ovate, slightly compressed, 0.6–0.75 × 0.4–0.5 mm, wingless.

Habitat. *Draba ucuncha* is found on karst slopes in páramo.

IUCN Red List category. *Draba ucuncha* is known only from the type collections and is therefore given the assessment of Data Deficient (DD) according to the IUCN (2001) criteria.

Phenology. *Draba ucuncha* has been collected flowering and fruiting in November.

Etymology. The specific epithet is named after Ucuncha District of Bolívar Province. It is a noun used in apposition and, therefore, is to be maintaind according to Article 23.1 of the International Code of Nomenclature for Algae, Fungi, and Plants (McNeill et al., 2012).

Discussion. *Draba ucuncha* most closely resembles *D. brackenridgei* (Bolivia and Peru, including Bolívar Province) in being a scapose perennial with ebracteate racemes, white flowers, oblong fruit, and 20 to 30 ovules per ovary. It differs, however, by having noncanescent (vs. canescent) leaves abaxially pubescent with rigid, simple, and fewer, stalked 2-rayed forked trichomes (vs. primarily soft, stalked, cruciform, and much fewer 3- or 5-rayed stellate trichomes), smaller petals, 1.8–2.2 × 0.4–0.5 mm (vs. [2.5–]2.8–4[–4.5] × [0.8–]0.9–1.2[–1.5] mm), fruit sparsely puberulent along valve margins (vs. glabrous or uniformly pubescent), and styles 0.07–0.15 (vs. 0.3–0.6) mm long.

Paratypes. PERU. **La Libertad:** Bolívar, Uchumarca, SW flank of Cerro Comulca, páramo on karst, 07°04′42″S, 77°46′17″W, 3900–4150 m, 9 Nov. 2013, *R. W. Bussmann, N. Paniagua Zambrana, C. Vega Ocaña & C. Téllez 18049* (HAO, MO, NY).

2. Draba xylopoda Al-Shehbaz, sp. nov. TYPE: Peru. La Libertad: Distr. Uchumarca, páramo at southern side of Comulca on dolomite, 07°04′48″S, 77°46′27″W, 3950 m, 27 Oct. 2012, *R. W. Bussmann, N. Paniagua Zambrana, C. Vega Ocaña & C. Téllez 17438* (holotype, MO-6688255; isotypes, HAO, NY). Figure 2.

Diagnosis. This species most closely resembles *Draba ochropetala* O. E. Schulz, from which it differs by having somewhat lax racemes elongated in fruit (vs. compact and not elongated), nodding (vs. ascending) flowers, dark yellow (vs. lemon-yellow or yellowish white) flowers, styles 2.5–3.5 (vs. 0.8–1.5) mm, and fruit valves densely pubescent with short-stalked stellate (vs. simple) trichomes.

Herbs perennial or subshrubs. Stems 10–35 cm, erect, woody, 1.5–4 mm in diam., simple or few branched above, rough with persistent, dry, non-decurrent leaf bases of previous seasons, pubescent throughout with minutely stalked, 4- to 6-rayed stellate trichomes. Leaves cauline, persistent at base, sessile, not auriculate, somewhat imbricate, not decurrent, oblong to oblong-lanceolate, sometimes narrowly ovate above, 7–15 × 3.5–5 mm, abaxial surface densely pubescent with 1- to 3-layered, short-stalked, appressed, rigid, 4- to 7(to 9)-rayed stellate trichomes 0.4–0.9 mm, adaxial surface exclusively with rigid, antrorse, subappressed, straight, simple trichomes 0.5–1.2 mm, these sometimes mixed with much smaller stalked stellate trichomes, base broadly cuneate to obtuse, margin entire or minutely 1- to 4-toothed on each side, not ciliate, apex obtuse; midvein somewhat prominent abaxially. Racemes bracteate throughout, 6- to 14-flowered, corymbose, densely flowered, elongated considerably in fruit; rachis densely pubescent as stem, straight; bracts similar to cauline leaves in shape and indumentum; lowermost fruiting pedicels divaricate-ascending, straight, 7–15 mm, densely pubescent all around with stalked stellate trichomes to 0.5 mm. Flowers nodding at anthesis; sepals yellowish, oblong to oblong-ovate, 3.5–5 mm, ascending, caducous, base not saccate, pubescent with stellate trichomes; petals dark yellow, obovate to spatulate, 5–7 × 2–2.7 mm, caducous, apex retuse; claw slightly differentiated from blade, 1–1.5 mm; filaments yellow, 3.5–4 mm, slender, dilated at base; anthers oblong, 0.6–0.9 mm, apiculate at apex; nectar glands confluent, subtending bases of all stamens; ovules 16 to 20 per ovary. Fruit silicles, oblong, 4–8 × 2.5–4 mm, slightly flattened, not twisted, sessile; densely pubescent with stellate trichomes, obtuse at apex and base; style 2.5–3.5 mm; stigma entire. Seeds not examined.

Habitat. *Draba xylopoda* is found on karst and dolomite in páramo.

Phenology. *Draba xylopoda* flowers in October to November.

IUCN Red List category. *Draba xylopoda* is known only from two collections and is therefore given the assessment of Data Deficient (DD) according to IUCN Red List (2001) criteria.

Etymology. The specific epithet refers to the woody foot or lower part of the stem.

Discussion. In most aspects of indumentum and leaf, flower color, shape, and size of parts, and fruit shape and size, *Draba xylopoda* most closely resembles the Peruvian-endemic *D. ochropetala*. However, it differs from the latter by having

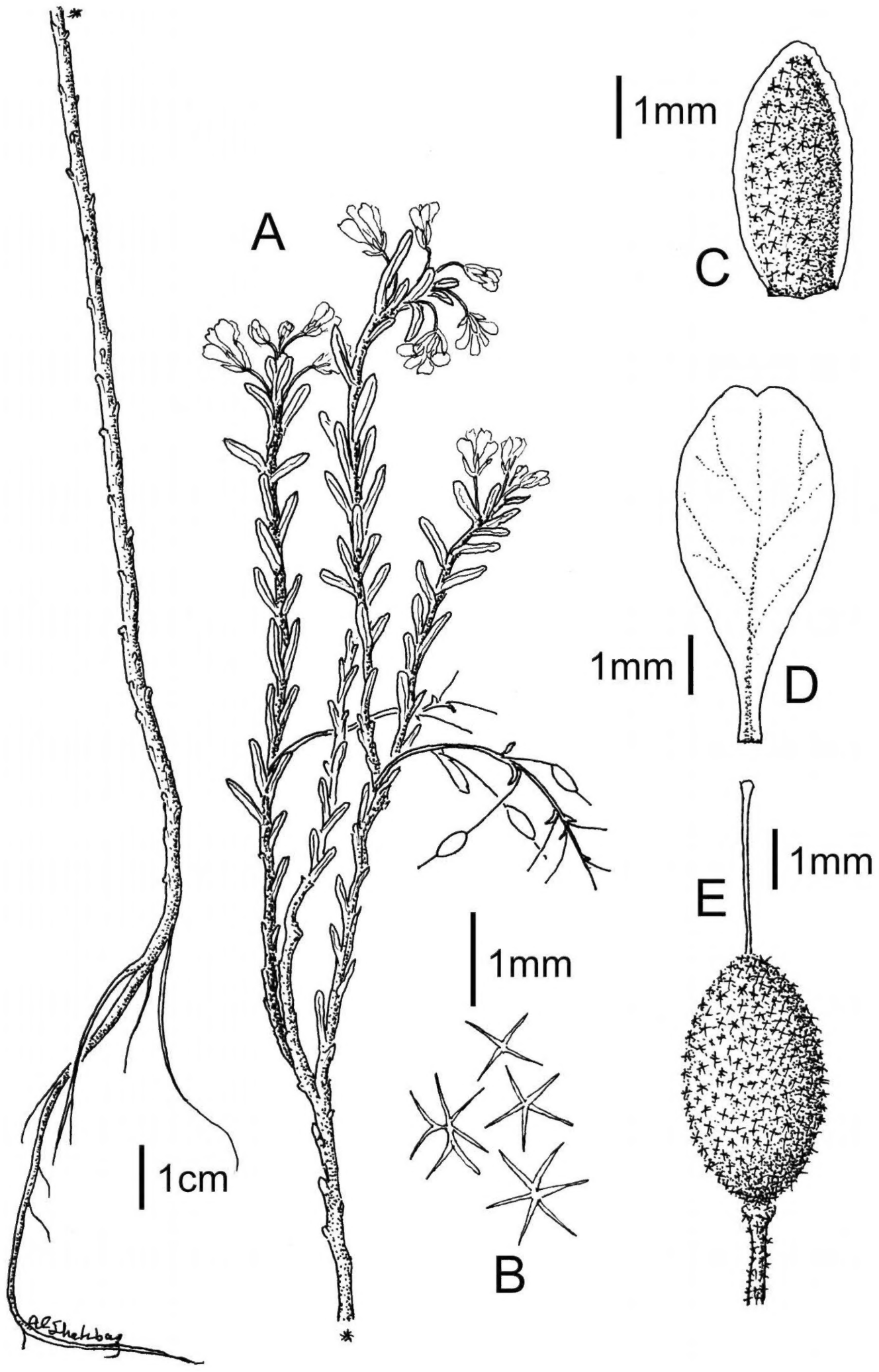

Figure 2. *Draba xylopoda* Al-Shehbaz. —A. Plant. —B. Trichomes. —C. Sepal. —D. Petal. —E. Fruit with style and fruiting pedicel. Drawn by Al-Shehbaz from the holotype *R. Bussmann et al. 17438* (MO).

somewhat lax racemes elongated in fruit, nodding flowers, simple stems few-branched distally, dark yellow flowers, fruiting pedicels 7–15 mm, longer styles 2.5–3.5 mm, and fruit valves densely pubescent with short-stalked stellate trichomes. By contrast, *D. ochropetala* has compact racemes not elongated in fruit, ascending flowers, stems several branched above the base, lemon-yellow or yellowish

white petals, fruiting pedicels (1–)2–5(–6) mm, fruit valves sparsely pubescent with simple trichomes, and shorter styles 0.8–1.5 mm.

In its general habit, bracteate raceme, leaf indumentum, and pedicel length, *Draba xylopoda* superficially resembles *D. cajamarcensis* Al-Shehbaz, but it differs by having dark yellow (vs. white) petals, 16 to 20 (vs. 10 to 16) ovules per ovary, longer styles 2.5–3.5 mm (vs. 0.6–1.1 mm), fruit valves pubescent with exclusively stellate, short-stalked (vs. simple and sessile 2[to 4]-rayed) trichomes, nodding (vs. ascending) flowers, stems pubescent with short-stalked, stellate (vs. malpighiaceous and sessile stellate) trichomes, and slightly larger sepals (3.5–5 vs. 2–3 mm) and petals (5–7 × 2–2.7 mm vs. 4–5 × 1.2–1.5 mm).

Paratypes. PERU. **La Libertad:** Bolívar, Distr. Ucuncha, S side of Cerro Fila de Andonsa, sharp windswept karst, 07°07′14″S, 77°49′23″W, 3900 m, 14 Nov. 2013, *R. W. Bussmann, N. Paniagua Zambrana, C. Vega Ocaña & C. Téllez 18321* (HAO, GH, K, MO).

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A Revision of the Mexican Endemic *Asta* (Brassicaceae)

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Abstract. The monospecific, Mexican endemic *Asta* Klotzsch & O. E. Schulz is divided into three subpecies. The new combinations *A. schaffneri* (S. Watson) O. E. Schulz subsp. *pringlei* (O. E. Schulz) Al-Shehbaz and *A. schaffneri* subsp. *stricta* (Rollins) Al-Shehbaz are proposed. *Asta schaffneri* subsp. *pringlei* is widespread in east-central Mexico, *A. schaffneri* subsp. *schaffneri* is endemic to San Luis Potosí, and *A. schaffneri* subsp. *stricta* is restricted to Hidalgo and Queretaro States. A key to the three subspecies is presented, and a neotype for *A. pringlei* O. E. Schulz is designated.

Key words: *Asta*, Asteae, Brassicaceae, Cruciferae, Mexico.

During work on the Brassicaceae (Cruciferae) for the World Flora Online and for the comprehensive Brassicaceae database, or BrassiBase (Koch et al., 2012; Kiefer et al., 2014), several smaller genera needed detailed generic descriptions and nomenclatural adjustments parallel to those already completed. Among such genera is the Mexican endemic *Asta* Klotzsch & O. E. Schulz.

Schulz (1933) recognized two species in *Asta* (*A. schaffneri* (S. Watson) O. E. Schulz and *A. pringlei* O. E. Schulz), and three years later (Schulz, 1936) he placed the genus in the Lepidieae, a tribe he characterized solely on the presence of angustiseptate fruits (flattened at a right angle to the septum). As shown by subsequent authors (see Al-Shehbaz et al., 2006, and references therein), however, such fruit type evolved independently numerous times in the family, and it currently occurs in at least 23 of 51 tribes (author's compilation). Rollins (1941), on the other hand, reduced *A. pringlei* to a variety of *A. schaffneri*, and he (Rollins, 1984) described *A. stricta* Rollins as a new species.

Asta was not assigned to a tribe by Al-Shehbaz et al. (2006), but based on sequence data of the nuclear ribosomal ITS region, Warwick et al. (2010) placed the genus in the unigeneric tribe Asteae, a well-resolved clade with 100% bootstrap support. The latter authors suspected that the Asteae may also include the monospecific, Mexican endemic *Scoliaxon* Payson due to sharing some remarkable morphological similarities (see below). However, a subsequent study using the ITS region (Warwick et al., 2011) supported the placement of both genera into independent tribes. Both tribes are currently recognized as members of Expanded Lineage II of the Brassicaceae (Al-Shehbaz, 2012; Koch et al., 2012; Kiefer et al., 2014). It is highly desireable that the Asteae and Scoliaxoneae are subjected to molecular studies using chloroplast markers to further confirm their tribal identity and to resolve the suspected infraspecific hybridization within *A. schaffneri*.

Although *Asta* and *Scoliaxon* differ in trichome morphology, fruit type, seed arrangement, and cotyledonary type, they share several characters in common. The most notable of these is the presence of a pair of well-developed, white, ovoid to subulate "projections" at the points of attachment of cauline leaves and pedicels to the stem. Although similar structures occur sporadically elsewhere in other genera of the family, none resembles those of *Asta* and *Scoliaxon* in size and color. These projections were described by Rollins (1984) as "vesicle- or scale-like emanation" if at the leaf base and as "horn-like structures" if at the pedicel base, whereas Marais (1970) called them stipules in *Heliophila* L. if found at the leaf base and bracts if at the pedicel base. Weberling (1955) also considered these structures as stipules when present at the node but failed to interpret their presence at the pedicel insertion. The presence versus absence of these projections can vary among species of a given genus, and, therefore, they are useful taxonomically. However, because of the lack of detailed developmental studies, the nature of these projections remains unresolved, though they should not be confused with the multicellular glands on multiseriate stalks that are found in the vast majority of taxa in the tribes Anchonieae, Buniadeae, Chorisporeae, and Dontostemoneae.

The lack of agreement between Schulz (1933, 1936) and Rollins (1993) on the number of taxa in *Asta* and the availability of substantial additional material encouraged the following study.

I. Asta Klotzsch & O. E. Schulz, Bot. Jahrb. Syst. 66: 91. 1933. TYPE: *Asta schaffneri* (S. Watson) O. E. Schulz. (lectotype, designated by Rollins [1941: 196]).

Plants annual or perennial herbs, sometimes subshrubs. Trichomes absent or occasionally minute and vesicle-like. Multicellular glands absent. Stems erect to ascending, simple or branched basally, many branched apically, often 4-angled, sometimes woody at base. Leaves cauline, sessile, attenuate to petiole-like base, not auriculate, entire, with 2, white, well-developed ovoid to subulate projections at the node. Racemes many-flowered, ebracteate, lax, elongated considerably in fruit; rachis straight; fruiting pedicels erect, and appressed or subappressed to rachis, or ascending, horizontal, to slightly recurved, straight to slightly curved or sigmoid, persistent, with a pair of white, ovoid to subulate projections at base. Sepals ovate, free, deciduous, ascending, unequal, base of lateral pair saccate; petals white, erect at base with flaring blade, longer than sepals; blade obovate, apex obtuse; claw strongly differentiated from blade, subequaling sepals, glabrous, unappendaged, entire; stamens 6, slightly exserted, erect, tetradynamous; filaments wingless, unappendaged, glabrous, free; anthers ovate, not apiculate; nectar glands confluent, subtending bases of filaments, median nectaries present; ovules 6 to 12 per ovary; placentation parietal. Fruit dehiscent, capsular silicles, oblong to ovoid, angustiseptate at base, slightly latiseptate at apex, not inflated, unsegmented; valves papery, with a prominent midvein, glabrous, keeled at least basally, smooth, wingless, unappendaged; gynophore obsolete or rarely to 1.7 mm; replum rounded, visible; septum complete, membranous, veinless; style rarely to 1 mm, persistent; stigma capitate, entire, unappendaged. Seeds uniseriate, wingless, oblong, usually plump; seed coat smooth, mucilaginous when wet; cotyledons incumbent or oblique.

Distribution. One species and three subspecies are endemic to east-central Mexico.

1. Asta schaffneri (S. Watson) O. E. Schulz, Bot. Jahrb. Syst. 66: 91. 1933.

Plants glabrous or puberulent with vesicular trichomes along stem angles, pedicels, and fruit. Stems 5–35(–50) cm, sometimes woody at base, strongly angled to narrowly winged, puberulent or glabrous above, much-branched. Middle cauline leaves linear to narrowly lanceolate, 1–3.5 cm × 1–4(–8) mm, base attenuate, margin entire, apex obtuse or retuse; uppermost cauline leaves progressively smaller, often linear. Raceme strongly elongated in fruit; fruiting pedicels slender, 2.5–7(–10) mm. Sepals ovate, 1.5–2 mm, white membranous at apex, glabrous; petals white, 3–5 × 1.5–2 mm; claw ca. 2 mm; filaments 1.5–2 mm; anthers ca. 0.5 mm. Fruit ovoid to oblong, 2–5(–6) × 1.5–2 mm, glabrous or with vesicular trichomes along replum or midvein; gynophore 0.1–1.7 mm, slender, style 0.2–1 mm. Seeds ovate, plump, 0.9–1.1 × 0.5–0.7 mm.

KEY TO *ASTA SCHAFFNERI* SUBSPECIES

1a. Fruiting pedicels divaricate to horizontal or descending, curved or sigmoid, not appressed to rachis; Aguascalientes, Coahuila, Nuevo León, San Luis Potosí, Tamaulipas, Zacatecas .... *A. schaffneri* (S. Watson) O. E. Schulz subsp. *pringlei* (O. E. Schulz) Al-Shehbaz

1b. Fruiting pedicels erect to erect-ascending, appressed or subappressed to rachis.

2a. Fruit oblong, 3–5(–6) mm; gynophore 0.1–0.4(–0.6) mm; San Luis Potosí .... *A. schaffneri* (S. Watson) O. E. Schulz subsp. *schaffneri*

2a. Fruit ovoid, 2–2.6 mm; gynophore 0.5–1.7 mm; Hidalgo and Queretaro .... *A. schaffneri* (S. Watson) O. E. Schulz subsp. *stricta* (Rollins) Al-Shehbaz

1a. Asta schaffneri (S. Watson) O. E. Schulz subsp. **schaffneri**. Basionym: *Capsella schaffneri* S. Watson, Proc. Amer. Acad. Arts 17: 322. 1882. TYPE: Mexico. San Luis Potosí: San Miguelito Mtns., 1876, *J. G. Schaffner 151* (holotype, GH-00018816; isotype, BM-001191175).

Fruits oblong, 3–5(–6) mm; fruiting pedicels erect to erect-ascending, subappressed to rachis; gynophore 0.1–0.4 mm.

Phenology. *Asta schaffneri* subsp. *schaffneri* has been found to flower in November.

Distribution. *Asta schaffneri* subsp. *schaffneri* is found at elevations from 1600 to 1700 m in San San Luis Potosí, Mexico.

Additional specimens examined. MEXICO. **San Luis Potosí:** E of Nuñez, San Luis Potosí–Ant. Morelos rd., Km. 84, *Rzedowski 210* (MICH); Villar, *Orcutt 5414* (MO, US); Agua Media, *Purpus 4907* (BM, F, GH, MO, UC, US); near San Luis Potosí, *J. G. Schaffner 554* (B, BM, GOET, HBG, NY, US).

Labels of *Schaffner 554* have the collection number given as "No. 554 Schaffner 151" and collection year as 1879 instead of 1876 as on the holotype sheet. The type locality (San Miguelito Mountains) was cited in Watson's (1882) original description of the species but was not given in *Schaffner 554*. Although listed as isotypes on JSTOR (<http://plants.jstor.org>), *Schaffner 554* is not part of the type collection of *Asta schaffneri*.

Asta schaffneri subsp. *schaffneri* appears to be endemic to San Luis Potosí and is rather uncommon. The range of *A. schaffneri* subsp. *pringlei* (see below) also extends into San Luis Potosí, and the two subspecies apparently hybridize. One collection annotated by Rollins as subspecies *schaffneri* (*Rollins & Tryon 58193*, GH, MO, NY, UC), which was collected 50 miles northeast of San Luis Potosí on the road to Matehuala in San Luis Potosí, likely represents a fertile hybrid of the two subspecies, and it is perfectly intermediate morphologically between them. However, field, experimental, and molecular studies, especially using nuclear and chloroplast markers, are needed to confirm that.

1b. Asta schaffneri subsp. **pringlei** (O. E. Schulz) Al-Shehbaz, stat. nov. Basionym: *Asta pringlei* O. E. Schulz, Bot. Jahrb. Syst. 66: 91. 1933. *Asta schaffneri* var. *pringlei* (O. E. Schulz) Rollins, Contr. Dudley Herb. 3: 197. 1941. TYPE: Mexico. Coahuila: Carneros Pass, thin soil of limestone ledges, 27 Sep. 1890, *C. Guernsey Pringle 3271* (neotype, designated here, MO-591793; isoneotypes, BM-001191174, BR-000000699276, BR-000000864001, BR-000000699341, CM-0668, COLO-00348169, E-00499944, GH-0018817, HBG-506274, KFTA-0000220, MEXU-00013884, MEXU-00013891, MU-00000098, NDG-02870, NY-00172682, NY-00172683, UC-117822, US-00731335, US-00100077, W-1891-0000921, W-1936-0002764).

Fruits oblong, rarely ovoid, 2.5–5.5 mm; fruiting pedicels divaricate to horizontal or slightly descending, curved or sigmoid, never appressed to rachis; gynophore 0.2–0.4(–0.6) mm.

Phenology. *Asta schaffneri* subsp. *pringlei* is found to flower from April to November.

Habitat. *Asta schaffneri* subsp. *pringlei* is found in calcareous gravelly soils and talus, limestone, chaparral, arroyos, sandstone outcrops, and gypsum hillsides at 1500–3100 m.

Additional specimens examined. MEXICO. **Aguascalientes:** ca. 20 km E Rincón de Romos, rd. to Asientos, betw. Cerro Altamira & Cerro de San Juan, *McVaugh 23670* (GH, MICH); N Cerro San Juán, 5 km E Tepezalá, *Rzedowski 24989* (MICH); near Km. 21 on hwy. betw. Rincon de Romos & Loreto, *Hartman & Funk 4080* (US). **Coahuila:** San Lorenzo Canyon, 6 mi. SE Saltillo, *Palmer 698* (GH, NY, US), *Palmer 411* (GH, MO, NY, US); Carneros, *Pennell 17297* (US); Carneros Pass, 26 mi. S Saltillo, *Rollins & Tryon 58136* (F, GH, MICH, MO, NY, TEX, UC, US); 29 mi. S Saltillo near Mex. Hwy. 54, *Rollins & Roby 7491* (GH, MO, NY, US); 3 km SW Fraile, *Stanford et al. 314* (GH, MO); 18 mi. W of Concepción del Oro on Coahuila–Zacatecas border, *Stanford et al. 571* (DS, GH, MO, NY, UC); Rancho Los Angeles, 54 km S Saltillo, *Villarreal & Cantrell 2152* (GH); Sierra Zapaliname, *Hinton 20490* (GH, TEX). **Nuevo León:** Mpio. Rayones, Cerro Blanco, *Hinton 20193* (GH, TEX); Mpio. Galeana, Mex 57, 4.3 km S of rd. to Puerto Mexico, ca. 10 km S of Coahuila state line, *Bridges & Woodruff 13113* (NY, TEX); ca. 5.5 mi. NW of San Rafael, *Henrickson 22654* (TEX); ca. 8 mi. NE of San Antonio, *Henrickson 22802* (RSA, TEX); La Escondida, Aramberri, *Hinton 23589* (CAS, TEX); C del Voladero, Mpio. Galeana, *Hinton 18744B* (TEX); El Sauce, Mpio. Galeana, *Hinton 18081* (TEX); ca. 11 mi. E of jct. of Hwys. 60 & 57 near San Pablo, *Oliver et al. 1064* (MO); 8 mi. W of Iturbide, *Correll & Johnston 19835* (GH, NY, TEX); E Pto. Los Encinos, on Linares–Galeana hwy., *Ripley & Barneby 13575* (CAS, NY); ca. 30 km ENE of Doctor Arroyo, 2.5 km ENE of San Antonio de Peña Nevada, *Nesom 4287* (GH, TEX); 14 km W of Doctor Arroyo, *Shreve & Tinkham 9642* (GH, UC); 34 mi. S of Saltillo, near Hwy. 57, *Rollins & Roby 76064* (GH, MO, NY); 4 mi. S of turn-off to Hacienda de San Jose Raices, betw. Saltillo & Matehuala, *Rollins & Tryon 58182* (GH, US); Mpio. de Derrumbadero, Cañon de los Capulines above San Enrique, Hacienda San Jose de Raices, *Mueller 2388* (F, GH, MICH, MO); 15 mi. SW of Pueblo Galeana, *Mueller 526* (GH); 37 km N of Dr. Arroyo on rd. to Galeana, *Breedlove & Mahoney 72168* (CAS); 18 mi. E of Matehuala, *Flyr 1541* (GH). **San Luis Potosí:** Charcas, *Lundell 5315* (MICH, NY, US); 8 km NE Laguna Seca, Km. 20 on San Luis Potos–Ant. Morelos, *Rzedowski 6334* (MICH); 22 km S Matahuala, 23°25′5–25″N, 100°38′50″–39′W, *Johnston et al. 11109* (CAS, GH, LL, MO, NY). **Tamaulipas:** 4 km W Miquihauana, *Stanford et al. 621* (DS, GH, MO, NY, UC); 0.5 mi. E of Hermano, *Stanford et al. 2490* (DS, NY, US); 15 km S Palmillas, *McDonald 1084* (TEX); Mpio. Miquihuanan, El Cargadero, 15 km NW Estanque de los Walle, *Hernandez, Martínez & Palomo 2066* (TEX); 10 km SW Altamira, *Hernandez et al. 1959* (TEX). **Zacatecas:** Sierra del Astillero, 24°34′N, 101°04–06W′, *Johnston et al. 11565L* (LL), *Johnston et al.* 11551B (LL); Sierra Madre Oriental, Concepción del Oro, *Pennell 17424* (F, GH, MICH, NY, US).

Discussion. Schulz (1933) did not cite any collections under his rather brief diagnosis of *Asta pringlei*. Although Rollins (1941: 197) did not designate a type either, he assumed that "*Pringle 3271* represents the entity Schulz had in mind. In any case, that collection has been used as a point of reference in the present instance." It is likely that Schulz examined a specimen of that collection number, but we are uncertain if such a specimen was annotated by him and exists somewhere. It is quite possible that such a specimen may have been at B but was destroyed during World War II. Pringle did not collect any material other than his *3271*, of which I have examined all 21 duplicates cited above. Until a specimen of *A. pringlei* with Schulz's annotation is discovered, the above arbitrary neotype designation is needed.

Asta schaffneri subsp. *pringlei* is the most widespread and highly variable of the three subspecies of *A. schaffneri*. The variation is most noticeable in the length and orientation of the fruiting pedicel, size, shape, and degree of compression of the fruit, seed number, and the presence versus absence or density of the vesicular papillae on the fruit replum. However, none of the variation falls into consistent, geographically delimited patterns that merit further subdivision of the taxon.

Two chromosome counts of $n = 10$ are known for *Asta schaffneri* subsp. *pringlei* from Coahuila and Nuevo León (Rollins & Rüdenberg, 1977, 1979, respectively). No counts are available for the other two subspecies of *A. schaffneri*.

1c. Asta schaffneri subsp. **stricta** (Rollins) Al-Shehbaz, comb. et stat. nov. Basionym: *Asta stricta* Rollins, Contrib. Gray Herb. 214: 19. 1984. TYPE: Mexico. Hidalgo: "cerca de la cumber del cerro Cangandó, proximo a Encarnación," 2700–2800 m, 15 Sep. 1961, *L. Paray 3198* (holotype, ENCB; isotype, MICH).

Fruit ovoid, 2–2.6 mm; fruiting pedicels erect, appressed to rachis; gynophore 0.5–1.7 mm.

Phenology. *Asta schaffneri* subsp. *stricta* flowers from September to November.

Distribution and habitat. *Asta schaffneri* subsp. *stricta* is found in oak woodland at 1900–2800 m in Hidalgo and Queretaro, Mexico.

Additional specimens examined. MEXICO. **Queretaro:** Mpio. Arroyo Seco, Sótano del Barro, S Santa María de Cocos, *Carranza 2950* (CAS, MICH, TEX).

Discussion. The characters used by Rollins (1984, 1993) to separate *Asta schaffneri* from *A. stricta* show a great deal of continuity, and they do not hold to justify the recognition of two distinct species. For example, Rollins indicated that the pedicel in *A. stricta* is 7–10 mm long and in *A. schaffneri* it is 3–7 mm. The isotype of *A. stricta* has pedicels 4–7 mm long, whereas in *A. schaffneri* subsp. *pringlei* (*Hinton 20496*) they are is up to 10 mm. Furthermore, the protrusion of the valve into the stylar area of *A. stricta* varies within the type collection, and comparable situations occur sporadically in *A. schaffneri*. In all aspects of the plant, there are no sharp distinctions between the taxa, and that might be indicative of infraspecific hybridization. Because the three entities recognized herein are geographically separated, I prefer to recognize them at the subspecific rather than specific rank.

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Three New Genera in the Tribe Euclidieae (Brassicaceae)

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Abstract. The new monospecific genera *Anzhengxia* Al-Shehbaz & D. A. German, *Metashangrilaia* Al-Shehbaz & D. A. German, and *Rudolf-kamelinia* Al-Shehbaz & D. A. German are described, and the supporting data for their recognition and the characters distinguishing them from related genera of the tribe Euclidieae are discussed. The new combinations *A. yechengnica* (C. H. An) Al-Shehbaz & D. A. German, *M. forrestii* (W. W. Sm.) Al-Shehbaz & D. A. German, and *R. korolkowii* (Regel & Schmalh.) Al-Shehbaz & D. A. German are proposed.

Key words: *Anzhengxia*, Asia, Brassicaceae, Cruciferae, Euclidieae, *Metashangrilaia*, *Rudolf-kamelinia*.

Following the first Brassicaceae (or Cruciferae)-wide molecular phylogenetic study (Beilstein et al., 2006) and the first phylogenetic tribal classification of the family (Al-Shehbaz et al., 2006), tremendous advances were made during the past decade, especially in relation to generic assignments and boundaries, tribal delimitations, and age and diversification of the family. The literature covering these three aspects is too voluminous to list, and the interested reader should consult the following papers and references cited within (Beilstein et al., 2008, 2010; German et al., 2009; Khosravi et al., 2009; Couvreur et al., 2010; Warwick et al., 2010; Al-Shehbaz, 2012; Hohmann et al., 2015; Franzke et al., 2016; Huang et al., 2016).

The numbers of tribes and new or synonymized genera have also increased substantially (e.g., German & Al-Shehbaz, 2008, 2010; Al-Shehbaz et al., 2011; Al-Shehbaz, 2012; Koch et al., 2012a; German & Friesen, 2014). As currently enumerated, the family includes 51 tribes, 340 genera, and 3840 species (author's preliminary compilation). The wealth of taxonomic, cytological, bibliographic, and phylogenetic data on the Brassicaceae is now readily available on the comprehensive database BrassiBase (see Koch et al., 2012b; Kiefer et al., 2014; <http://brassibase.cos.uni-heidelberg.de/>). In addition, several studies focused on the phylogenetic relationships and limits of individual tribes, including, for a general overview, the Alysseae (Warwick et al., 2008; Rešetnik et al., 2013; Li et al., 2015; Španiel et al., 2015), Anchonieae–Chorisporeae–Euclidieae–Hesperideae (Warwick et al., 2007), Arabideae (Al-Shehbaz et al., 2011; Koch et al., 2012a; Karl & Koch, 2013), Boechereae (Alexander et al., 2013), Brassiceae (Warwick & Sauder, 2005; Arias & Pires, 2012), Chorisporeae (German et al., 2011), Cochlearieae (Koch, 2012), Dontostemoneae (Friesen et al., 2016), Erysimeae (Moazzeni et al., 2014), Eudemeae (Salariato et al., 2015), Halimolobeae (Bailey et al., 2007), Heliophileae (Mummenhoff et al., 2005; Mandáková et al., 2012), Lepidieae (Mummenhoff et al., 2009), Microlepidieae (Heenan et al., 2012), Physarieae (Fuentes-Soriano & Al-Shehbaz, 2013), and Schizopetaleae and/or Thelypodieae (Warwick et al., 2009; Toro-Núñez et al., 2013; Cacho et al., 2014).

Phylogenetic studies by Warwick et al. (2004, 2007) dealt with the Euclidieae but did not cover all genera of this tribe. However, they clearly showed that three species (*Sisymbriopsis yechengnica* (C. H. An) Al-Shehbaz, C. H. An [as Z. X. An] & G. Yang, *Braya forrestii* W. W. Sm., and *Neotorularia korolkowii* (Regel & Schmalh.) Hedge & J. Léonard) did not fall into monophyletic clades that included the type species of the genera in which they were placed. That, and additional family-wide studies (see below), supported the exclusion of these species into new monospecific genera herein proposed as *Anzhengxia* Al-Shehbaz & D. A. German, *Metashangrilaia* Al-Shehbaz & D. A. German, and *Rudolf-kamelinia* Al-Shehbaz & D. A. German, respectively. Detailed descriptions and distributions of the three species are found in Zhou et al. (2001) and Al-Shehbaz (2015) and need not be repeated here.

ANZHENGXIA

The species transferred herein to the new monospecific genus *Anzhengxia* was originally described by An (1981) as *Microsisymbrium yechengnicum* C. H. An. Schulz (1924) established the genus *Microsisymbrium* O. E. Schulz to include three Himalayan species and a fourth from the southwestern United States and adjacent Mexico. However, *Microsisymbrium* is illegitimate because it included the type of the earlier-published *Guillenia* Greene. Al-Shehbaz and O'Kane (1999) assigned the Himalayan species of *Microsisymbrium* to various genera, and the species above was transferred by Al-Shehbaz et al. (1999) to *Sisymbriopsis* Botsch. & Tzvelev, a genus that seemed then to be the best fit for the species.

Ribosomal ITS sequence data by Warwick et al. (2004, 2007) included two of the five species of *Sisymbriopsis*, *S. mollipila* (Maxim.) Botsch. and *S. yechengnica*, but not the generic type, *S. schugnana* Botsch. & Tzvelev. However, *S. mollipila* shares many morphological characters (especially in fruit, indumentum, flower, and seed) with *S. schugnana* that *S. yechengnica* does not, and it is considered here to be the better representative of the genus. The molecular data clearly show that *S. mollipila* and *S. yechengnica* belong to two well-supported clades including different species groups of *Neotorularia* Hedge & J. Léonard. The latter species differs from the other taxa currently placed in *Sisymbriopsis* by having exclusively simple (vs. simple and/or stalked forked or dendritic) trichomes, longitudinally 2-veined (vs. veinless) septa, slightly recurved (vs. straight) fruiting pedicels, obtuse (vs. apiculate) anthers, broadly obovate (vs. oblanceolate) petals 6–10 (vs. 2–4) mm long, and apically winged (vs. wingless or rarely distally apiculate) seeds. *Anzhengxia* (pronounced an-zeng-shia) is named in honor of Professor An Zhengxi, former director of the Xinjiang Agricultural University herbarium (XJA) and an expert on the Brassicaceae of China and the author of many new species, including the one on which the new genus is based.

I. Anzhengxia Al-Shehbaz & D. A. German, gen. nov. TYPE: *Anzhengxia yechengnica* (C. H. An) Al-Shehbaz & D. A. German.

Herbs annual. Trichomes simple, crisped, flattened. Multicellular glands absent. Stems erect to subdecumbent. Basal leaves petiolate, not rosulate, simple, dentate to pinnatifid; cauline leaves petiolate to subsessile, not auriculate at base, entire or dentate upward. Racemes many-flowered, ebracteate, elongated considerably in fruit; rachis straight; fruiting pedicels ascending to divaricate, slightly recurved. Sepals oblong, free, deciduous, erect, equal, base of lateral pair not saccate; petals white to pink, erect at base with flaring blade, distinctly longer than sepals; blade obovate, apex obtuse; claw slightly differentiated from blade, much shorter than sepals, glabrous, unappendaged, entire; stamens 6, exserted, erect, tetradynamous; filaments wingless, unappendaged, glabrous, free; anthers narrowly oblong, not apiculate; nectar glands confluent, lateral ringlike and surrounding bases of lateral stamens, median nectaries subtending bases of median pairs; ovules 20 to 28 per ovary; placentation parietal. Fruit dehiscent, capsular siliques, linear, latiseptate, not inflated, unsegmented; valves papery, with a prominent midvein and 2 marginal veins, glabrous or pubescent, not keeled, strongly torulose, wingless, unappendaged; gynophore obsolete; replum rounded, visible; septum complete, membranous, with 2 longitudinal veins; style to 1 mm, cylindrical, persistent; stigma capitate, entire, unappendaged. Seeds uniseriate, winged distally, oblong, flattened, papillate, mucilaginous when wetted; cotyledons incumbent.

1. Anzhengxia yechengnica (C. H. An) Al-Shehbaz & D. A. German, comb. nov. Basionym: *Microsisymbrium yechengnicum* C. H. An, Bull. Bot. Res., Harbin 1(1–2): 99. 1981. ≡ *Sisymbriopsis yechengnica* (C. H. An) Al-Shehbaz, C. H. An & G. Yang, Novon 9: 312. 1999. TYPE: China. Xinjiang: Yecheng Xian, Kunlun Shan, 1 July 1974, 3000 ft., *Anonymous 3347* (holotype, HNWP; isotype, PE).

The species is endemic to Xinjiang Province, China.

METASHANGRILAIA

The original placement by Smith (1913) of *Braya forrestii* in *Braya* Sternb. & Hoppe remained for more than a century, though Schulz (1924), who did not examine any material of the species, did not recognize it and considered it to be doubtfully distinct from *B. aenea* Bunge, a synonym of *B. rosea* Bunge. Using ITS sequence data, Warwick et al. (2004) demonstrated that *B. forrestii* formed a well-supported clade sister to the rest of *Braya* and that it had quite distinct sequences separated from other *Braya* species by more than 40 steps and higher divergence percentage. More recently, Al-Shehbaz et al. (2004) and Al-Shehbaz and German (2014) considered the species to be morphologically anomalous in *Braya* and suggested that it should be placed in a monospecific genus. *Braya forrestii* has exclusively simple trichomes, whereas the rest of *Braya*

has forked, submalpighiaceous, or substellate trichomes sometimes mixed with simple ones. Trichome morphology in the Euclidieae is extremely diversified (Al-Shehbaz et al., 2006) and, therefore, quite valuable in the separation of most genera and species in this tribe. The species also differs from *Braya* by having dark purple (vs. green or lavender) sepals and fruit as long as or shorter than the calyx. In the majority of *Braya* species, the fruit is distinctly longer than the calyx, though in *B. tibetica* Hook. f. & Thomson they are not. Although both *B. forrestii* and *Shangrilaia* Al-Shehbaz, J. P. Yue & H. Sun have exclusively simple trichomes, the former has sessile (vs. stipitate) fruit, complete (vs. perforate) septum, rosulate and linear to oblanceolate (vs. cauline and acicular) leaves, and several-flowered racemes (vs. solitary flowers). For these reasons, we prefer to place *B. forrestii* into the well-defined, monospecific *Metashangrilaia*, a genus related to *Shangrilaia* and resembling *Braya*.

II. Metashangrilaia Al-Shehbaz & D. A. German, gen. nov. TYPE*: Metashangrilaia forrestii* (W. W. Sm.) Al-Shehbaz & D. A. German.

Herbs perennial, densely caespitose, scapose, pilose; caudex woody, to 3 cm in diam. at simple base, numerous branched, densely covered with petiole remains of previous years. Trichomes simple. Multicellular glands absent. Stems erect to ascending. Basal leaves petiolate, rosulate, simple, entire; cauline leaves absent. Racemes several-flowered, ebracteate, corymbose, not elongated in fruit; rachis straight; fruiting pedicels ascending, persistent. Sepals ovate or oblong, free, persistent, often dark purple distally, erect, equal, base of lateral pair not saccate; petals purple, pink, or white, erect at base with slightly flaring blade, ascending, longer than sepals; blade obovate, apex rounded; claw slightly differentiated from blade, shorter than sepals, glabrous, unappendaged, entire; stamens 6, included, erect, slightly tetradynamous; filaments wingless, unappendaged, glabrous, free; anthers oblong, not apiculate; nectar glands confluent, subtending bases of all stamens; ovules 4 to 8 per ovary; placentation parietal. Fruit dehiscent, capsular silicles, ovoid, terete, not inflated, unsegmented; valves papery, veinless, glabrous or pubescent, not keeled, smooth, wingless, unappendaged, gynophore obsolete; replum rounded, visible; septum complete, membranous, veinless; style to 1 mm, stout, cylindric, persistent; stigma capitate, entire, unappendaged. Seeds biseriate, wingless, oblong, plump, mucilaginous when wetted; cotyledons incumbent.

1. Metashangrilaia forrestii (W. W. Sm.) Al-Shehbaz & D. A. German, comb. nov. Basionym: *Braya forrestii* W. W. Sm., Notes Roy. Bot. Gard. Edinburgh 8: 119. 1913. TYPE: China. Yunnan [S Hengduan], W flank of Lichiang Range, 27°20′N, 12,000–13,000 ft. [3658–3962 m], June 1910, *G. Forrest 5749* (holotype, E 00022629; isotypes, BM 000550160, K 00072534, PE).

The species is distributed primarily in Xizang and Yunnan (China) and is known from a single gathering in neighboring Bhutan.

Rudolf-Kamelinia

This new monospecific genus is proposed to accommodate *Sisymbrium korolkowii* Regel & Schmalh., a species transferred by Schulz (1924) to the illegitimate later homonym *Torularia* (Coss.) O. E. Schulz, where it was accepted for over 50 years, and then by Hedge and Léonard in Léonard (1986) to *Neotorularia* Hedge & J. Léonard, where it has been maintained to the present. Although seven species of *Neotorularia* were included in an ITS-based phylogenetic study by Warwick et al. (2004), two were nested within *Braya*, but the remaining five, including the generic type *N. torulosa* (Desf.) Hedge & J. Léonard, fell in a polytomy and did not form a monophyletic clade. However, the *trn*L sequence data of these authors showed a weakly supported clade for the same five species. This discrepancy among the nuclear and chloroplast phylogenies might well be indicative of reticulate evolution, which would explain the controversial morphological patterns, paucity of reliable characters to delimit *Neotorularia* and related genera, and difficulties in finding the proper taxonomic relationship. Subsequent phylogenetic studies that included *N. torulosa* and either *N. korolkowii* (Khosravi et al., 2009) or its sister *Dichasianthus subtilissimus* (Popov) Ovcz. & Junussov (Warwick et al., 2007; German et al., 2009) have clearly demonstrated that *N. korolkowii* should not be maintained in *Neotorularia*.

There is no unique apomorphy clearly separating *Neotorularia korolkowii* from the rest of *Neotorularia*, and it is necessary to use a combination of characters to distinguish them. It differs from *N. torulosa* and other species currently maintained in the genus by having yellowish (though sometimes pinkish or white; vs. exclusively pinkish or white) petals, slender and well-developed (vs. stout and obsolete) styles distinctly narrower than (vs. nearly as wide as) fruit (except for *N. dentata* (Freyn & Sint.) Hedge & J. Léonard), and fruiting pedicels though stout but

narrower than (vs. about as wide as) fruit (except for *N. brevipes* (Kar. & Kir.) Hedge & J. Léonard). From the morphologically closest *N. dentata*, *N. korolkowii* can also be distinguished by its exclusively Y-shaped branched trichomes on leaves and fruits (vs. several forked to subdendritic) and by having simple (vs. lacking) trichomes on leaves (Yunussov, 1978; Zhou et al., 2001).

Al-Shehbaz (2015) suggested that *Neotorularia korolkowii* ought to be excluded from *Neotorularia*. ITS sequence data (Warwick et al., 2007; German et al., 2009) indicated that the species and monospecific *Dichasianthus* Ovcz. & Junussov are sister taxa. Although Soják (1982) transferred the species to *Dichasianthus*, the two taxa have very little in common. *Neotorularia korolkowii* differs from *D. subtilissimus* by having stalked, forked (vs. exclusively simple) trichomes, rosulate (vs. non-rosulate) basal leaves, straight (vs. strongly flexuous) raceme rachis, usually yellowish (vs. pink or purple) petals, confluent (vs. four distinct, lateral) nectar glands, plump (vs. flattened) seeds, and terete (vs. strongly latiseptate) fruit. Therefore, based on molecular and morphological data, *N. korolkowii* is transferred herein to the monospecific *Rudolf-kamelinia*, a genus named in honor of our late colleague Rudolf Vladimirovich Kamelin (12 Aug. 1938–1 Apr. 2016), an academician and renowned expert on the flora of Middle and Central Asia, former president of the Russian Botanical Society, and long-time curator of the herbarium of vascular plants in the V. L. Komarov Botanical Institute, St. Petersburg, Russia.

III. Rudolf-kamelinia Al-Shehbaz & D. A. German, gen. nov. TYPE: *Rudolf-kamelinia korolkowii* (Regel & Schmalh.) Al-Shehbaz & D. A. German.

Herbs annual or biennial, rarely short-lived perennial. Trichomes stalked, 1- or 2-forked, sometimes mixed with simple ones on lower plant parts. Multicellular glands absent. Stems erect to ascending, 1 or few from base. Basal leaves petiolate, rosulate, simple, entire or dentate; cauline leaves similar to basal, sessile or subsessile, not auriculate. Racemes several- to many-flowered, ebracteate, corymbose, elongated considerably in fruit; rachis straight; fruiting pedicels erect to ascending, persistent, narrower than fruit. Sepals oblong, free, deciduous, erect, equal, base of lateral pair not saccate; petals white, sometimes with yellowish center, erect at base with flaring blade, longer than sepals; blade broadly obovate, apex retuse; claw only slightly differentiated from blade, much shorter than sepals, glabrous, unappendaged, entire; stamens 6, slightly exserted, erect, slightly tetradynamous; filaments wingless, unappendaged, glabrous, free; anthers oblong, apiculate; nectar glands lateral, semilunar, median glands absent; ovules 14 to 26 per ovary; placentation parietal. Fruit dehiscent, capsular siliques, linear, terete, not inflated, apically curved, unsegmented; valves papery, with somewhat distinct midvein, pubescent with short-stalked, 2-rayed trichomes, not keeled, rounded, torulose, wingless, unappendaged; gynophore absent; replum rounded, visible; septum complete, somewhat thickened, veinless; style 1–2 mm, cylindric, persistent; stigma capitate, slightly 2-lobed, lobes free, not decurrent, opposite replum, unappendaged. Seeds uniseriate, wingless, oblong, plump; seed coat not mucilaginous when wetted; cotyledons incumbent.

1. Rudolf-kamelinia korolkowii (Regel & Schmalh.) Al-Shehbaz & D. A. German, comb. nov. Basionym: *Sisymbrium korolkowii* Regel & Schmalh., Trudy Imp. S.-Peterburgsk. Bot. Sada 5: 240. 1877. TYPE: [Kyrgyzstan]. Pass Dolon & gorge O...uka, Apr. 1872. *Korolkow s.n.* (holotype, LE).

The species is distributed in Afghanistan, China, India, Kazakhstan, Kyrgyzstan, and Tajikistan. Records from Mongolia and Turkmenistan cannot be confirmed (see German, 2009, 2015, and Bondarenko, 1974, respectively).

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A New Species of *Erisma* (Vochysiaceae) from Panama

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Abstract. A new species of *Erisma* Rudge, *E. panamense* M. L. Kawas., S. Castillo & McPherson, is here described, illustrated, and assigned IUCN conservation status.

Key words: *Erisma*, Panama, Vochysiaceae.

Erisma Rudge (Vochysiaceae) consists of 16 species of trees distributed in lowland forests from South America, mostly in Amazonian Brazil, to Panama, where until recently only one species was known to occur (Kawasaki, 1998). However, collecting for the botanical inventory of the Minera Panamá S.A. copper mining site (Donoso District, Colón Province) has recently revealed the presence of a new species of the genus from this area. It is described and illustrated here, and thus becomes the 24th published species to be based on specimens collected for the inventory (Barrie et al., 2016).

Erisma panamense M. L. Kawas., S. Castillo & McPherson, sp. nov. TYPE: Panamá. Colón: Donoso, Minera Panamá, Botija Camp S_02, 8°51′11.4″N, 80°38′22.8″W, 132 m, 4 June 2014, *S. Castillo 405* (holotype, PMA; isotype, MO). Figures 1, 2.

Diagnosis. Similar to *Erisma nitidum* DC. in having flower buds with a cylindric spur, but it differs in its purple petal (vs. white with a yellow center).

Tree ca. 7 m; hairs where present yellowish to yellowish brown, stellate. Leaves opposite, the blades chartaceous, elliptic to ovate, 8–17 × 3.5–6.5 cm, puberulous to glabrous or with a few trichomes in the axils of lateral veins on the lower surface; apex acuminate; base obtuse; midvein on the upper surface raised near base, forming a narrow ridge, plane to sulcate toward apex, prominent below; lateral veins 6 to 10 pairs, prominent on both surfaces, angle with midvein 60°–70°; marginal vein 1–2 mm from margin; petiole canaliculate, 8–10 mm; stipules subulate, ca. 1 mm, deciduous. Inflorescences panicles of cincinni, 7–13 cm, peduncles and lateral branches densely pubescent to puberulous; outer bracteoles suborbicular to obovate, ca. 2 mm, the inner ones linear, ca. 1 mm, bracts and bracteoles deciduous; pedicels ca. 1 mm; flower buds ca. 4 mm; calyx lobes 5, unequal, the largest one spurred, ca. 4 mm, its outer side sepal-like, its inner side petal-like, the spur cylindric, straight, 1–3 mm, deciduous with the largest calyx lobe; other calyx lobes 1–1.5 mm; petal 1, purple, obcordate, unguiculate, ca. 4 × 4 mm, villous within, puberulous without; stamen 1, ca. 3 mm, the anther sagittate, ca. 2 mm; style ca. 3 mm, the stigma terminal, capitate; ovary inferior, uniloc-ular; ovules 2, apical. Fruits unknown.

Phenology. *Erisma panamense* has been collected with flowers in June.

Distribution and habitat. *Erisma panamense* is known only from the type collection in Panama, in the lowland rainforests of Donoso District, Colón.

IUCN Red List category. *Erisma panamense* is evaluated as Critically Endangered (CR: B2ab) according to IUCN criteria (IUCN, 2001), because the single known collection was made in the Minera Panamá mining area and thus the site is threatened by clearing.

Etymology. *Erisma panamense* is named after the country of Panama.

Discussion. This new species is similar to *Erisma nitidum* DC., a species from French Guiana and

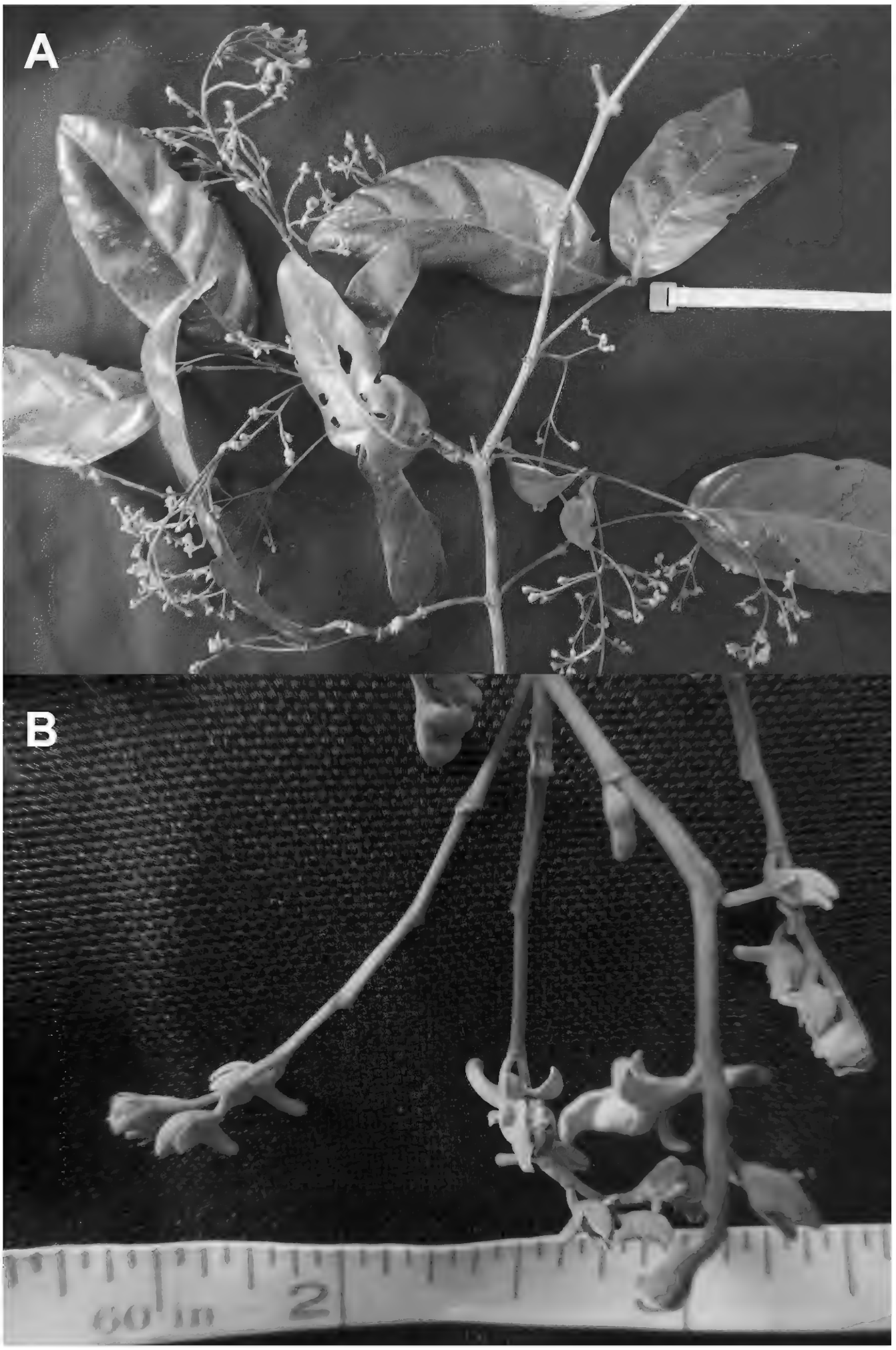

Figure 1. *Erisma panamense* M. L. Kawas., S. Castillo & McPherson. —A. Leaves and flowers. —B. Flowers. Photos from *S. Castillo 405* (MO), taken from TROPICOS® (<www.tropicos.org>).

Guyana, in the color of indument, morphology of leaves, and in the shape of the spur of the largest calyx lobe; in *E. panamense*, however, the cylindric spur is shorter (1–3 mm vs. ca. 4 mm) and the petal is purple (vs. white, yellow in the center). It is also superficially similar to *E. micranthum* Spruce ex Warm., a species from Venezuelan and northern Brazilian Amazon, in the relatively small flowers, but it differs in the color of the indument (yellowish to yellowish brown vs. grayish), shape of the spur (cylindric vs. globose), and the color of the petal (purple vs. yellowish, red at base). *Erisma blancoa*

Figure 2. *Erisma panamense* M. L. Kawas., S. Castillo & McPherson. Photo of the isotype *S. Castillo 405* (MO).

Marc.-Berti was thus far the only species of the genus known in Panama; in this species, the petal is yellowish, ca. 10 mm (vs. purple, ca. 4 mm in *E. panamense*), the stipules are conspicuous (ca. 4 mm vs. 1 mm, inconspicuous), and the leaves are larger (14.5–27 × 5–10 cm vs. 8–17 × 3.5–6.5 cm), usually subcordate (vs. obtuse) at the base. These four species are compared in the key below.

Key to *Erisma panamense* and Related Species

1a. Indument grayish; spur globose ..... *E. micranthum* Spruce ex Warm.
1b. Indument yellowish to yellowish brown; spur cylindric.
  2a. Petal purple ..... *E. panamense* M. L. Kawas., S. Castillo & McPherson
  2b. Petal white to yellowish.
    3a. Midvein of leaves sulcate above ..... *E. nitidum* DC.
    3b. Midvein of leaves raised above ..... *E. blancoa* Marc.-Berti

Acknowledgments. We are grateful to Professor Mireya Correa, Director of the Herbario de la Universidad de Panamá (PMA), and to Curator Jim Solomon of MO for professional courtesies and for facilitating access to the collections under their care. We thank José De Gracia of Minera Panamá S.A. for permission to reproduce the photos in Figure 1 and the Panamanian Ministry of Environment (MIAMBIENTE) for authorization to export duplicate collections to collaborating institutions. Helpful suggestions from Amy Litt and Luis Marcano-Berti are also acknowledged.

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Nomenclatural Novelties in *Rosa* (Rosaceae) subgenus *Rosa* Recognized in North America

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Abstract. New taxa and nothotaxa are described within North American *Rosa* L. subg. *Rosa*. *Rosa setigera* Michx., formerly considered of Eurasian origin and placed in *Rosa* sect. *Systylae* DC., is segregated into the new *Rosa* sect. *Americanae* W. H. Lewis. Its origin is proposed to be in the Ozark Plateau of the south-central United States. One new species, *R. memoryae* W. H. Lewis, and one new subspecies, *R. virginiana* Mill. subsp. *minidentata* W. H. Lewis, are described. Twelve new *Rosa* nothospecies are described: *Rosa* ×*atlantica* W. H. Lewis, *Rosa* ×*canadensis* W. H. Lewis, *Rosa* ×*churchillii* W. H. Lewis, *Rosa* ×*fernaldiorum* W. H. Lewis, *Rosa* ×*gilmaniana* W. H. Lewis, *Rosa* ×*hainesii* W. H. Lewis, *Rosa* ×*harmsiana* W. H. Lewis, *Rosa* ×*hodgdonii* W. H. Lewis, *Rosa* ×*massiana* W. H. Lewis, *Rosa* ×*oldhamii* W. H. Lewis, *Rosa* ×*peraxeliana* W. H. Lewis, and *Rosa* ×*victoriana* W. H. Lewis. All of these are naturally produced hybrids rather than cultivated plants. The existing nothospecies *Rosa* ×*engelmannii* S. Watson, of parentage *R. acicularis* Lindl. × *R. nutkana* C. Presl, is divided into three nothosubspecies: nothosubspecies *engelmannii*, nothosubspecies *occidentalis* W. H. Lewis, and nothosubspecies *britannicae-columbiae* W. H. Lewis, distinguished by parentage involving three different subspecies of *R. nutkana*. New hybrid introgressions identified in Canada and the United States are briefly discussed.

Key words: *Rosa* sect. *Americanae*, hybridization, introgression, North America, nothospecies, nothosubspecies, *Rosa setigera*, Rosaceae, section, subspecies.

The author has been studying North American roses for almost 60 years (e.g., Lewis, 1958a, 2008; Lewis et al., 2015). Many nothospecies are known in this group, and new taxa continue to be discovered. This publication presents an assortment of new taxa and nothotaxa that herbarium studies have shown to merit recognition, including a new endemic section, one species, one subspecies, 12 nothospecies, and two nothosubspecies, and discusses observations of introgression.

New Section in *Rosa* subg. *Rosa*

Rosa L. sect. **Americanae** W. H. Lewis, sect. nov. TYPE: *Rosa setigera* Michx., Fl. Bor-Amer. 1: 295. 1803.

Haec sectio nova a *Rosae* L. ceteris sectionibus americanis omnibus plantis dioeciis floribus masculis foemineisque dimorphis distinguitur.

Rosa sect. *Americanae* and its sole species, *R. setigera*, are distinguished from all other American *Rosa* species by cryptically dioecious rather than hermaphroditic flowers. Male plants have more flowers per inflorescence than female plants, while carpellate flowers expand more as they age compared to staminate flowers. Anthers in male plants are about 2 mm long while those in female plants are about 1 mm. long. Staminate flowers are considered to have more pollen than carpellate flowers and so receive greater attention from pollinators. Female flowers may produce malformed pollen while males do not, generally resulting in fewer and smaller hips among carpellate plants and more and larger hips among staminate plants (Lewis, 1959a; Kevan et al., 1990; Zlesak et al., 2013; Zuzek & Zlesak, 2014).

Stems of *Rosa setigera* are procumbent, often growing to 3–5 m long in one season, or climbing to 60 dm; second-year stems produce short ascending flowering branches with few small prickles (Fig. 1). Stamens average 200 per flower, which is greater than other species of *Rosa* in North America (Erlanson, 1934). For further details of the morphology of *R. setigera*, see Kemp (1993a, 1993b) and Lewis et al. (2015).

Discussion. *Rosa setigera* has been placed in the otherwise Eurasian *Rosa* sect. *Systylae* DC. (whose name is corrected from *Synstylae*). Section

Figure 1. *Rosa setigera* Michx. habit, Ozark Plains.

Systylae had seemed to be the most reasonable placement for a new *Rosa* in Europe of unknown origin. However, botanists (author included) have been slow to recognize that *R. setigera*, native only to North America, has unique features distinct from section *Systylae*. Most importantly, with rare exceptions in Eurasia, all other species of *Rosa*, including those of section *Systylae*, are monoecious, whereas *R. setigera* is cryptically dioecious. Therefore, this paper removes it from section *Systylae* and summarizes evidence supporting its placement in a new *Rosa* section, *Americanae* W. H. Lewis, which includes only that species.

Rosa setigera has pollen of 31–36 μm diameter (Lewis, 1959a). This is larger than the pollen of seven diploid ($2n = 14$) North American *Rosa* species, which average 27–29 μm diameter, and similar in size to the pollen of the three tetraploid species ($2n = 28$) in North America east of the Rocky Mountains, *R. arkansana* Porter, *R. carolina* L., and *R. virginiana* Mill. Further, chromosome morphology of *R. setigera* differs from diploid species examined east of the Rocky Mountains since individual chromosomes are larger, the longest about 5 μm in length, while those of other diploid species are about 3 μm in length. This increase in chromatin is clearly associated with the greater cell size observed for *R. setigera* pollen (Lewis, 1959a).

Flavonoid patterns show that *Rosa* sect. *Systylae* is well defined by the 3-O-glucoside and 3-O-rhamnoside of kaempferol. That section is probably the best known group among wild roses studied (Grossi et al., 1998). While the 15 Eurasian *Rosa* species of section *Systylae* examined are chemically homogenous, *R. setigera* is quite distinct from them. This distinction is further confirmed by the research of Grossi et al. (1997) on flavonoid and enzyme polymorphisms. Separation of *R. setigera* from the Eurasian species of section *Systylae* also appears justifiable in view of molecular data published to date (Joly & Bruneau, 2006; Joly et al., 2006; Bruneau et al., 2007). Fougère-Danezan et al. (2015) further suggested that the removal of *R. setigera* is justified if *Rosa* sect. *Systylae* is separated regionally.

The epicenter of *Rosa setigera* distribution, based on specimen density, is in the American Ozark Plateau region that includes Missouri, Arkansas, and Oklahoma and nearby states throughout the south-central United States (COSEWIC, 2003a, 2003b). The borders of the Ozark Plateau are approximately between 36°N and 39°N latitude and 90°W and 94.5°W longitude, including the St. Francois Mountains and the Rolla quadrangle, 37°–38°N, 90°–2°W (Sauer, 1920; Nelson, 2012). The species has spread eastward or been introduced in eastern and southern states to New England and Florida, but is still

uncommon in much of that range. For instance, several years ago, I was collecting *Rosa* with botanists in New England when we stumbled on a typical *R. setigera*. To my surprise, no colleague knew of this long, spreading *Rosa* that extended over vegetation for many yards. The species was simply new to them, that is, it had only recently arrived from the central United States, perhaps due to humans bringing seeds or plants while doing road work using materials from the west.

In the west *Rosa setigera* is infrequent in the Great Plains and does not extend to the Rocky Mountains or to the west beyond. The species is rare in Canada, known only in southwest Ontario and in the United States southeast of the 85th parallel, having been introduced there from the Midwest over long periods of time (Oldham et. al., 2003).

The previous commonly used vernacular name for *Rosa setigera*, "Prairie rose," is clearly a misnomer for a species that is based in the ancient cratonic-tectonic unit between the Appalachians, Ouachitas, and Rocky Mountains of North America (Imes & Emmett, 1994). Therefore, I propose a new vernacular name, "Ozark rose," reflecting the mountainous region dominated by *R. setigera* in the south-central United States.

Distribution. *Rosa setigera* is found in Ontario, Canada, as well as Alabama, Arkansas, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Michigan, Mississippi, Missouri, Nebraska, New Hampshire, New Jersey, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas, Vermont, Virginia, West Virginia, Washington, D.C., and Wisconsin in the United States. *Rosa setigera* is naturalized in the Channel Islands, Europe.

New Species and Subspecies of *Rosa*

1. Rosa memoryae W. H. Lewis, sp. nov. TYPE: U.S.A. Texas: NW Wise Co., L. B. J. grasslands, N 33°24.520′, W 97°30.348′, 8 June 2014, *W. H. Lewis, R. J. O'Kennon & M. Elvin-Lewis 21525* (holotype, MO; isotype, BRIT). Figure 2.

Haec species *Rosae foliolosae* Nutt. affinis, sed ab ea statura humiliore, floribus minoribus atque petalis pallide roseis usque pallide rubris distinguitur.

Stems erect to deflexed, 1.4–2.5 dm, if upright to 17.5 cm tall, bark reddish brown on main stem, branches tan, glabrous with single or paired erect and sparse infrastipular prickles 2–3 mm, no intranodal prickles or aciculi. Leaves 3.3–5.5 cm, stipules 12–15 × ca. 2 mm, auricles deltoid, 1 mm, margins entire, eglandular, surfaces glabrous to puberulent; petiole and rachis with prickles, stipitate glandular; leaflets 7 to 9; terminal; blade lanceolate, 15–20 × 4–6 mm, membranous, long cuneate, margins simply serrate, teeth gland tipped or eglandular; teeth 9 to 11 per side, few gland tipped, apex acute, abaxial surfaces light green, glabrous, eglandular, exerted midveins with no pricklets or stipitate glands, adaxially deep green, lustrous, glabrous. Inflorescences single-flowered corymbs, pedicels erect, 1–2 mm, glabrous, stipitate glandular, bracts 2, ca. 1 × 2 mm, surfaces sparsely stipitate glandular. Flowers ca. 2.8 cm diam., hypanthium globose, ca. 2 × 3 mm (immature), glabrous, stipitate glandular, neck absent, sepals reflexed or spreading, lanceolate 13–15 × ca. 3.4 mm, petals light pink to light red, ca. 10 × 14 mm, hips 9–10 mm diam., globose, stipitate glandular.

Etymology. *Rosa memoryae* is named for Memory Elvin-Lewis, Ph.D., Professor, Washington University in St. Louis, D.Sc. (Honoris Causa) and Distinguished Alumnus, University of British Columbia, and D.Sc. (Honoris Causa), Andrews University, Michigan. Dr. Memory Elvin-Lewis has been an exceptional collaborator in numerous field trips to collect *Rosa* in North America and other taxa in South America.

Vernacular name. Memory's rose.

Discussion. *Rosa memoryae* is a miniature species found only in the Johnson Grasslands of Wise Co., Texas, some distance from the related *R. foliolosa* Nutt., which is taller with larger, white flowers. This area is considered to have a wide range of unique ecosystems, which may account for the scarcity of this species.

Paratype. U.S.A. **Texas:** Wise Co., E 5.7 mi. from Rhome, on hwy. 57, 4 Sep. 1945, *Whitehouse 10681* (BRIT [236518]).

2. Rosa virginiana Mill. subsp. **minidentata** W. H. Lewis, subsp. nov. TYPE: U.S.A. New York: Suffolk Co., Riverhead, 26 June 1938, *E. T. Moldenke & H. N. Moldenke 10623* (holotype, MO). Figure 3.

Haec subspecies a *Rosa virginiana* Mill. subsp. *virginiana* caulibus ramisque in partibus inferioribus plerumque dense setigeris aciculis necnon glandulis stipitatis praeditis atque foliolorum dentibus minoribus in quoque latere 12 distinguitur.

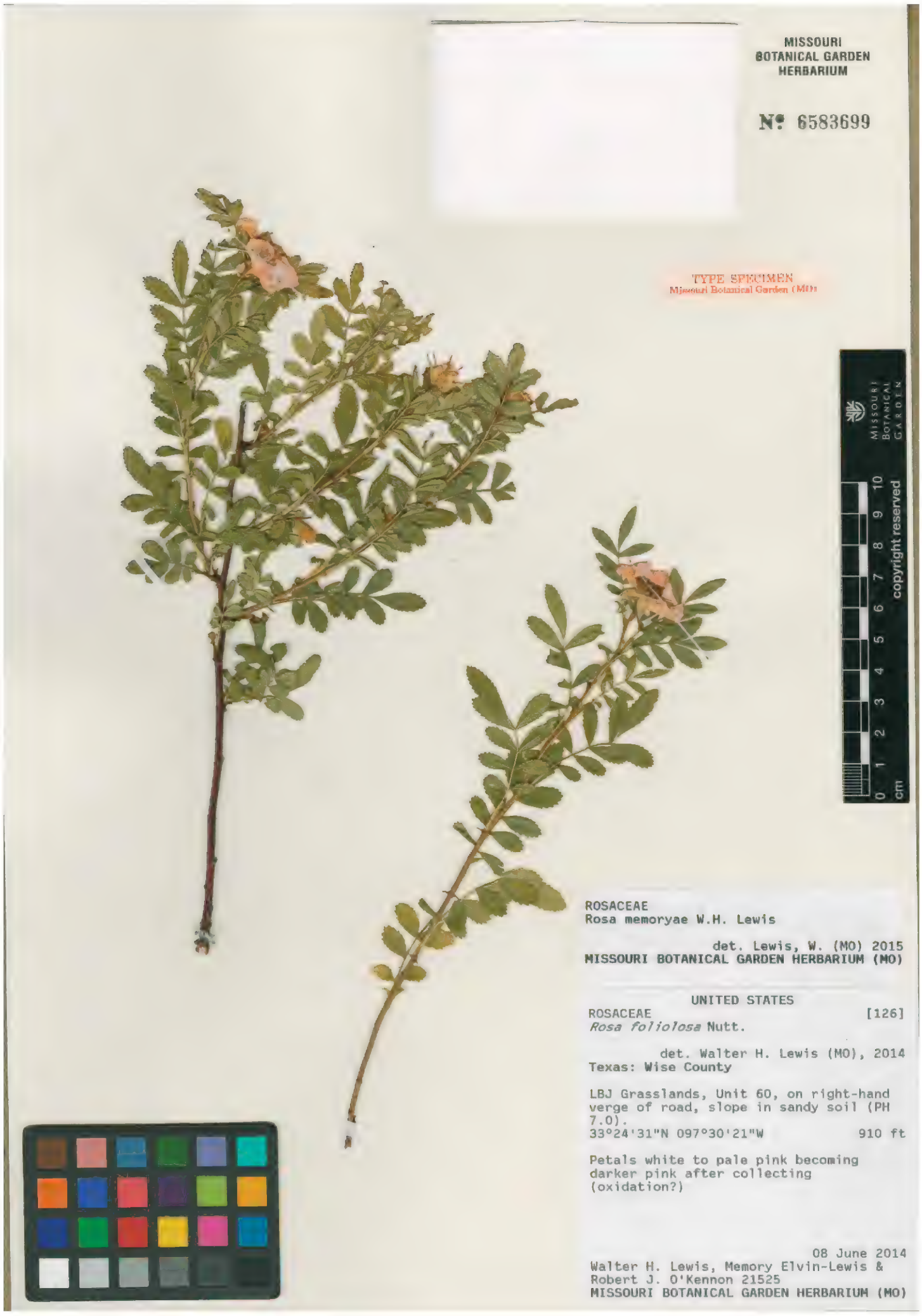
MISSOURI
BOTANICAL GARDEN
HERBARIUM
N° 6583699
TYPE SPECIMEN
Missouri Botanical Garden (MO)
MISSOURI BOTANICAL GARDEN
copyright reserved
0 1 2 3 4 5 6 7 8 9 10
cm
ROSACEAE
Rosa memoryae W.H. Lewis
det. Lewis, W. (MO) 2015
MISSOURI BOTANICAL GARDEN HERBARIUM (MO)
UNITED STATES
ROSACEAE [126]
Rosa foliolosa Nutt.
det. Walter H. Lewis (MO), 2014
Texas: Wise County
LBJ Grasslands, Unit 60, on right-hand verge of road, slope in sandy soil (PH 7.0).
33°24'31"N 097°30'21"W 910 ft
Petals white to pale pink becoming darker pink after collecting (oxidation?)
08 June 2014
Walter H. Lewis, Memory Elvin-Lewis & Robert J. O'Kennon 21525
MISSOURI BOTANICAL GARDEN HERBARIUM (MO)

Figure 2. *Rosa memoryae* W. H. Lewis. Holotype, *W. H. Lewis, R. J. O'Kennon & M. Elvin-Lewis 21525* (MO).

Rosa virginiana subsp. *minidentata* is similar to *R. virginiana* subsp. *virginiana*, except for the mostly densely setigerous lower stems and branches with aciculi and usually stipitate glands. The teeth are smaller and 12 per side.

Paratypes. CANADA. **New Brunswick:** Northumberland Co., Portage Island, 17 Sep. 1913, *S. F. Blake 5676* (K). **Newfoundland:** Conception Bay, 2 Oct. 2001, *W. H. Lewis & M. Elvin-Lewis 15765* (MO), Avalon Peninsula, La Manche Prov. Park, 3 Oct. 2001, *W. H. Lewis & M.*

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MISSOURI BOTANICAL GARDEN
0 1 2 cm
(Ellys T. Moldenke & Harold N. Moldenke 10623)
ROSACEAE [126]
Rosa virginiana subsp. minidentata W.H. Lewis
TROPICOS Image
MISSOURI BOTANICAL GARDEN 1247487 HERBARIUM
Flora of New York
Rosa virginiana Mill.
In dry sandy soil, Riverhead, Suffolk Co., New York. Very abundant and dense; corolla pink.
June 26, 1938
ELLYS T. MOLDENKE
HAROLD N. MOLDENKE } Collectors
No. 10623

Figure 3. *Rosa virginiana* Mill. subsp. *minidentata* W. H. Lewis. Holotype, *E. T. Moldenke & H. N. Moldenke 10623* (MO).

Elvin-Lewis 15769 (MO); St. Anthony, 2 May 2012, *W. H. Lewis & M. Elvin-Lewis 21478-cult.* (MO). **Nova Scotia:** Cape 4, Breton Island, Victoria Co., Baddeck, 14 Oct. 2004, *W. H. Lewis & M. Elvin-Lewis 15899* (MO); Digby Co., Culloden Rd. of Hwy. 101, 16 Oct. 2004, *W. H. Lewis & M. Elvin-Lewis 15905* (MO); Inverness Co., Pleasant Bay, 13 Oct. 2004, *W. H. Lewis & M. Elvin-Lewis 14897* (MO).

U.S.A. **Massachusetts:** Berkshire Co., Sheffield, State Rd. by old cellar, 7 June 1919, *C. R. Churchill s.n.*

(MO); Dukes Co., Martha's Vineyard, Edgartown, 6 July 1906, *G. G. Edwards s.n.* (ISC, MICH, MO); Martha's Vineyard, 12 Oct. 1927, *J. A. Arushel 6262* (MO). **Missouri:** Ralls Co., betw. Ely & Monroe City, along railway & rd., 16 Oct. 1934, *J. A. Steyermark 16278* (MO). **New Hampshire:** Coos Co., Whitefield, 2 mi. S, 30 June 1954, *W. H. Lewis 2173* (MO). **New York:** Suffolk Co., Fire Island, Ocean Bay Park, 23 Aug. 1958, *G. Eiten 1245* (MO). **Vermont:** Addison Co., Middlebury, 18 July 1901, *N. F. Flynn s.n.* (VT); Caledonia Co., Barnet, 7 Sep. 2009, *A. V. Gilman 9151* (MO, VT); Chittenden Co., Burlington, 30 July 1901, *N. F. Flynn s.n.* (VT); Rutland Co., North Pownal, North Hill, 23 July 1898, *W. W. Eggleston 200* (VT); Rutland Co., West Rutland, 9 July 2004, *A. V. Gilman & B. Popp 04070* (VT).

New Nothotaxa of *Rosa* in North America

Twelve new nothospecies are recognized, and two new nothosubspecies, in addition to an autonymic nothosubspecies, are recognized within *Rosa* ×*engelmannii* S. Watson. These nothotaxa are presented in alphabetical order; in Table 1 they are listed alphabetically according to their parental species.

1. Rosa ×atlantica W. H. Lewis, nothosp. nov. [*Rosa carolina* L. × *Rosa palustris* Marshall]. TYPE: U.S.A. Pennsylvania: Northampton Co., Island Park, above Easton, 18 July 1899, *T. C. Porter s.n.* (holotype, PH).

Haec nothospecies inter parentes *Rosam carolinam* L. et *R. palustrem* Marshall intermedia, sed a hac habitu suffrutescente caulibus debilibus, ab illa foliolis angustis firmiusculis subtiliter serrulatis atque aculeis curvatis falcatisve distinguitur.

Rosa ×*atlantica* resembles *R. palustris* with its narrow, rather firm, finely serrulate leaflets and curved to falcate prickles; the prickles are more slender or sometimes absent, and the flowers are usually solitary. The plant habit is like that of *R. carolina* subsp. *carolina*, often scattered subshrubs with weak stems, while *R. palustris* forms shrubby thickets.

Vernacular name. Atlantic rose.

Distribution. *Rosa* ×*atlantica* is found in Pennsylvania in the United States. There is shared distribution of both parental taxa in New Brunswick, Nova Scotia, Ontario, and Quebec in Canada, and in Alabama, Arkansas, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Iowa, Kentucky, Maine, Maryland, Massachusetts, Michigan, Mississippi, Missouri, New Hampshire, New Jersey, New York, North Carolina, Ohio, Pennsylvania, Rhode Island, South Carolina, Tennessee, Vermont, Virginia, West Virginia, Washington, D.C., and Wisconsin.

Discussion. *Rosa* ×*atlantica* is a rare nothospecies known only in Pennsylvania and nearby waterways along the Atlantic coast. The hybrid was briefly described by P. A. Rydberg (1918), who noted further distributions in New Hampshire and New Jersey. No material from the latter two states was seen for this study.

Pollen fertility. *Rosa palustris*, $n = 7$, × *Rosa carolina*, $n = 14$: highly sterile F1 (Erlanson, 1934).

2. Rosa ×canadensis W. H. Lewis, nothosp. nov. [*Rosa acicularis* Lindl. × *Rosa woodsii* Lindl.]. TYPE: Canada. Saskatchewan: Mile 53.5, Hwy. 102 (La Ronge–Southend Rd.), Otter rapids area, Churchill River, 7 Aug. 1975, *V. L. Harms 22748* (SASK). Figure 4.

Haec nothospecies inter parentes *Rosam acicularem* Lindl. et *R. woodsii* Lindl. intermedia, sed a hac cortice pallide brunneo, lamina foliari majore 20–60 mm longi marginibus latis uni- vel bidentato-serratis, stipulis marjoribus auriculis patentibus erectisve, corymbis 1- ad 3-floris, floribus majoribus atque sepalis elongatis patentibus erectisve; ab illa caulium aculeis plerumque nullis interdum binatis apicem versus nullis atque perianthiis fructiferis parvis globosis exaculeatis glandulis stipitatis angustis rectis solitariis binatisve munitis distinguitur.

Rosa ×*canadensis* resembles *R. acicularis* in having pale brown bark, larger leaf blades 20–60 mm with broad leaf margins, 1- to 2-dentate-serrate with larger stipules, auricles flared or erect, numerous glabrous teeth, corymbs 1- to 3-flowered, larger flowers with entire margins somewhat pubescent, elongated sepals spreading or upright with oldest hips forming groups of upright beak-capped sepals. Like *R. woodsii* its stems are mostly without prickles but prickles when present are typically paired, none toward the axes, few are infrastipular without acicula; some sepals are spreading and round, and the hips are small and lacking prickles with only narrow straight paired/single stipitate glands. Hypanthia with a neck occur in both parental species; in this nothospecies the hypanthia are variable in length and urceolate.

Vernacular name. Canada or Canadian rose. The nothospecies is most common in central Canada.

Table 1. New nothotaxa arranged in order of parental lineage.

Parental lineage	Nothotaxon name
Rosa acicularis Lindl. × *R. arkansana* Porter	*Rosa* ×*harmsiana* W. H. Lewis
Rosa acicularis Lindl. × *R. blanda* Aiton	*Rosa* ×*per-axeliana* W. H. Lewis
Rosa acicularis Lindl. subsp. *sayi* (Schwein.) W. H. Lewis × *R. nutkana* C. Presl subsp. *macdougalii* (Holz.) Piper	*Rosa* ×*engelmannii* S. Watson nothosubsp. *britannicae-columbiae* W. H. Lewis
Rosa acicularis Lindl. subsp. *sayi* (Schwein.) W. H. Lewis × *R. nutkana* C. Presl. subsp. *melina* (Greene) W. H. Lewis & B. Ertter	*Rosa* ×*engelmannii* S. Watson nothosubsp. *engelmannii*
Rosa acicularis Lindl. subsp. *sayi* (Schwein.) W. H. Lewis × *R. nutkana* C. Presl. subsp. *nutkana*	*Rosa* ×*engelmannii* S. Watson nothosubsp. *occidentalis* W. H. Lewis
Rosa acicularis Lindl. × *R. woodsii* Lindl.	*Rosa* ×*canadensis* W. H. Lewis
Rosa arkansana Porter × *R. woodsii* Lindl.	*Rosa* ×*oldhamii* W. H. Lewis
Rosa blanda Aiton × *R. carolina* L.	*Rosa* ×*gilmaniana* W. H. Lewis
Rosa blanda Aiton × *R. nitida* Willd.	*Rosa* ×*churchillii* W. H. Lewis
Rosa blanda Aiton × *R. virginiana* Mill.	*Rosa* ×*hainesii* W. H. Lewis
Rosa carolina L. × *R. nitida* Willd.	*Rosa* ×*fernaldiorum* W. H. Lewis
Rosa carolina L. × *R. palustris* Marshall	*Rosa* ×*atlantica* W. H. Lewis
Rosa carolina L. × *R. rugosa* Thunb.	*Rosa* ×*massiana* W. H. Lewis
Rosa nitida Willd. × *R. virginiana* Mill.	*Rosa* ×*hodgdonii* W. H. Lewis
Rosa nutkana C. Presl. × *R. pisocarpa* A. Gray	*Rosa* ×*victoriana* W. H. Lewis

Distribution. *Rosa* ×*canadensis* is found in Alberta, Manitoba, Northwest Territories, and Saskatchewan in Canada, and in Colorado, Minnesota, and Montana in the United States. There is shared distribution of both parental taxa in Alberta, British Columbia, Manitoba, Northwest Territories, Ontario, Saskatchewan, and Yukon in Canada, and in Alaska, Colorado, Iowa, Minnesota, Montana, North Dakota, South Dakota, and Wyoming in the United States.

Discussion. This nothotaxon is published as a nothospecies, with identity of the parents specified only to the species level. However, only *Rosa acicularis* subsp. *sayi* (Schwein.) W. H. Lewis and *R. woodsii* subsp. *woodsii* occur in the range where it is generally found.

Pollen fertility. *Rosa woodsii*, $n = 7$, × *Rosa acicularis*, $n = 21$: semi-fertile F1 (Erlanson, 1934).

Paratypes. CANADA. **Alberta:** Atikameg, Little Utikuma Lake, 8 July 1968, *M. G. Dumais & K. Anderson 3234* (ALTA); Peace-Athabasca Delta, Revillon Coupé; 28 June 1970; *M. J. Doherty 193* (ALTA); Fort Saskatchewan, 18 Aug. 1939, *G. H. Turner 1558* (ALTA); near Evansburg, jct. of Hwys. 16 & 16A, 24 June 1971, *W. H. Lewis 7754* (MO); 5 mi. NW of Grande Prairie, 18 June 1971, *J. D. Shorthouse 1B* (MO); 12.5 mi. E of Fort Saskatchewan, W of Elk Island Natl. Park, 20 June 1971, *W. H. Lewis 7744* (MO); Jasper Lake, Jasper Natl. Park, 6 July 1976, *D. D. Sharp A382* (ALTA); Acheson, 4–5 mi. W of Hwy. 60, S of Hwy. 16, 24 June 1971, *J. H. Whyte & W. H. Lewis s.n.* (ALTA); 2 mi. NE of Fort Saskatchewan, 1 Aug. 1939, *G. H. Turner 1421* (ALTA); N. Saskatchewan River, by Univ. of Alberta campus, 6 July 1982, *G. Donkersgoed 2* (ALTA); Snake Indian River Canyon, 18 July 1965, *P. W. Stringer s.n.* (ALTA); Head-smashed-in Buffalo Jump, main gully facing E, 10 Aug. 1982, *J. Campbell-Snelling & M. Chambers 1113* (ALTA, LEA); Windy Point Ridge, W of Hwy. 11, Abraham Lake, 14 Aug. 2007, *D. M. Fabijan 2803* (ALTA). **Manitoba:** 14.7 mi. S of Carberry, 4 Aug. 1968, *J. R. & D. L. Dugle 4096* (MMMN); Pinawa, 13 June 1969, *B. Ziola Z-72* (MMMN), 28 June 1969, *B. Ziola Z-144* (DUL, MMMN), 4 July 1969, *W. N. Chunys 2407* (MMMN). **Northwest Territories:** Lower Hay River, 15 July 1951, *W. H. Lewis 1203* (MO); 16 July 1951, *W. H. Lewis 1211* (MO). **Saskatchewan:** 2 mi. N McBride Lake resort, Pepaw River, 26 June 1930, *V. L. Harms, D. F Hopper & H. Baker 28451* (SASK); Antelope, 3 July 1968, *J. Looman 11667* (MO, SASK); Saskatchewan, Cluff Lake, 15 June 1977, *V. L. Harms 23857* (SASK); Candle Lake at Sandy Bay, 23 Aug. 1979, *V. L. Harms 27554B* (DAO, SASK); Dore Lake, 5 Aug. 1966, *H. W. Trafananko 65* (SASK); 3 mi. E of Langham, 25 June 1973, *J. D. Shorthouse 9A* (MO, SASK); Lipton, 22 June 1911, *J. W. Lelokey 1925* (MO); Meadow Lake Prov. Park, W Greig Lake, 8 July 1973, *V. L. Harms 20315* (SASK); Moose Mt. Provincial Park, 14 mi. N of Carlyle, 2 mi. W of Kenosee Lake, 23 June 1973, *V. L. Harms 19931* (DAO, SASK); 9 mi. N of Margo, Township 34, 28 June 1969, *B. Ziola Z-142* (MMMN); Prince Albert Natl. Park, SW, trail to Johnasson's Flats, 20 Aug. 2002, *V. L. Harms 44159* (MO, SASK).

U.S.A. **Colorado:** Larimer Co., Poudre Canyon, 17 June 1965, *C. B. Davis 367* (CSU, MO); 3.1 mi. W jct. US 287 & Colorado Rd. 14, 29 June 1982, *J. M. Ricketson 104* (CSU, MO); Insmont, July–Sep. 1915, *W. E. Ligget s.n.* (MO). **Minnesota:** Winona Co., Sitea,

MISSOURI BOTANICAL GARDEN
copyright reserved
0 1 2 3 4 5 6 7 8 9 10
cm
Type:
Rosa x Canadensis W. H. Lewis
(R. acicularis x R. woodsii ssp. woodsii)
Det. by Lewis, W. (MO) 2016
Missouri Botanical Garden (MO)
This may be: ANNOTATION LABEL
ROSA ACICULARIS Lindl. X R. WOODSII Lindl.
Det. by V.L. Harms May, 1986
The W.P. Fraser Herbarium, University of Saskatchewan, Saskatoon (SASK).
FLORA OF SASKATCHEWAN, CANADA
ROSA WOODSII Lindl. X R. ACICULARIS Lindl.
Mile 53.5; Hwy 102 (La Ronge - Southend Road)
Otter Rapids area on Churchill River
55° 39' N; 104° 44' W
Tall Populus tremuloides forest with some admixed Picea glauca
August 7, 1975
COL.: VERNON L. HARMS #22748
FRASER HERBARIUM, UNIVERSITY OF SASKATCHEWAN, SASKATOON
61561

Figure 4. *Rosa* ×*canadensis* W. H. Lewis. Holotype, *V. L. Harms 22748* (SASK).

Mississippi River, 13 June 1975, *S. D. Swanson 480* (MO). **Montana:** Gallatin Co., ca. 12 mi. NE of Bozeman, Bridger Mtns., 18 July 1945, *C. L. Hitchcock & C. V. Muhlick 12467* (MO); Judith Basin Co., South Judith River, 1 Sep. 1896, *J. H. Flodman* 613 (NY).

3. Rosa ×churchillii W. H. Lewis, nothosp. nov. [*Rosa blanda* Aiton × *Rosa nitida* Willd.]. TYPE: U.S.A. Massachusetts: Franklin Co., Deerfield, 13 June 1888, *J. R. Churchill 496* (holotype, MO). Figure 5.

0 1 2 3 4 5 6 7 8 9 10
cm
copyright reserved
MISSOURI BOTANICAL GARDEN
(Joseph R. Churchill 496)
ROSACEAE [126]
Rosa x churchillii W.H. Lewis
det. W. H. Lewis (MO), 2015
Rosa x churchillii W. H. Lewis
R. blanda Ait x R. nitida Wild.
Det. by Lewis, W. (MO) 2015
Missouri Botanical Garden (MO)
[J. R. Churchill 496]
ROSACEAE
Rosa blanda Aiton
See Vol. 20 Rhodora p. 91-94 (1918)
MISSOURI BOTANICAL GARDEN HERBARIUM (MO)
HERBARIUM OF J. R. CHURCHILL.
Rosa blanda, Ait.
496.
Deerfield, Mass.
June 13, 1888.
Coll. J. R. C.

Figure 5. *Rosa* ×*churchillii* W. H. Lewis. Holotype, *J. R. Churchill 496* (MO).

Haec nothospecies parentibus *Rosae blandae* Aiton et *R. nitidae* Willd. similis, sed ab ambabus statura intermedia distinguitur.

Rosa ×*churchillii* is similar to *R. nitida* in having dark brown bark and openly branched stems, internodal prickles commonly found on distal branches, but like *R. blanda*, these are rare or absent on lower stems that are thin, indent, and smaller in size. Also like *R. nitida* are its stipules (12 × 3 mm), auricles (2.5–4 mm) with tip flared and eglandular,

leaf teeth 13 to 15 per side and sometimes gland-tipped, corymbs 1 to 3, eglandular bracts 10–17 × 4–7 mm and styles 0.5 mm beyond stylar orifice. It resembles *R. blanda* in lacking infrastipular prickles, petioles and rachis lacking pricklets but sometimes having pubescent glands, leaf blades that are elliptic to ovate, short pedicels (9–12 mm) with few stipitate glands, a 3-mm neck, sepals eglandular with some beak-capped. Intermediate between its 2 parents or smaller in size are its leaflets (1.5–2.5 cm × 1.5–1 cm, margins 1-serrate, apex acute), leaflets (6 to 7, terminal), flowers (2.5–5 cm) and petals (15 × 10–20 mm). Like both its parents it has pink to rose petals and globose fruit.

Etymology. *Rosa* ×*churchillii* is named for Joseph R. Churchill, an attorney and botanist who was a prodigious collector of *Rosa* in eastern North America during the 19th century.

Vernacular name. Churchill's rose.

Distribution. *Rosa* ×*churchillii* is found in Quebec in Canada, and in Illinois, Indiana, Maine, Massachusetts, and Vermont in the United States. There is shared distribution of both parental taxa in New Brunswick, Nova Scotia, Ontario, and Quebec in Canada, and Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont.

Discussion. *Rosa* ×*churchillii* occurs in coastal, lake, and riparian areas in the Northeast and, to a lesser degree, the upper Midwest. It is under environmental pressure on Monhegan Island and other coastal areas widely invaded by introduced species, such as the barberry, that are greatly restricting and destroying native vegetation (Bangor Daily News, 2003). Its possible hybrid status was recognized by Fernald (1918).

Paratypes. CANADA. **Quebec:** Muntane Co., 2 mi. S of Mont Joli, edge of woods, stems up to 1.5 m tall, 11 June 1955, *W. H. Lewis 2469* (MO).

U.S.A. **Illinois:** Lake Co., *M. C. Jensen s.n.* (MO). **Indiana:** Morgan Co., Madison Township, Millers, dry sands, 9 Sep. 1896, *L. M. Umbach s.n.* (MO). **Maine:** Lincoln Co., Monhegan Island, 16 Aug. 1921 & 26 Aug. 1921, *J. R. Churchill s.n.* (MO); Hancock Co., Cranberry Isles, swamp, 21 Aug. 1888, *E. L. Rand 8665* (MO); Seal Harbor above Long Pond, 11 Sep. 1888, *J. H. Redfield 14105* (MO); Piscataquis Co., Dover, [unknown date], *M. L. Fernald 234* (GH). **Massachusetts:** Franklin Co., Deerfield, 5 June 1965, *R. M. Poland* (MO). **Vermont:** Orleans Co., Willoughby Mountain, 25 Aug. 1886, *J. R. Churchill s.n.* (MO).

4. Rosa ×engelmannii S. Watson in Gard. & Forest 2: 376, fig. 121. 1889 (pro sp.) [*Rosa acicularis* Lindl. × *Rosa nutkana* C. Presl]. TYPE: U.S.A. Cultivated from seed collected by Engelmann above Empire, Colorado, *Sargent s.n.* (lectotype, designated by Rydberg [1918: 507] GH).

Discussion. *Rosa engelmannii* was named by Sereno Watson to honor George J. Engelmann, 1809–1884, German/American botanist, physician, and meteorologist who is greatly admired for his contributions to the Missouri Botanical Garden. Erlanson (1929) proposed that *R. engelmannii* was likely to be a hybrid between *R. acicularis* and *R. nutkana*, and later (Erlanson, 1934) formally treated it as a hybrid. It is relatively common, occurring in the western range of *R. acicularis* subsp. *sayi* from Alaska to Colorado (Lewis, 1959b) and to British Columbia (Hultén, 1968). The three nothosubspecies hereby established allow the recognition of the hybrids derived from *R. acicularis* subsp. *sayi* (the only subspecies present in most of North America, though at least one collection of the usually Eurasian subspecies *acicularis* is known from Alaska [Lewis, 1959b]) and three different subspecies of *R. nutkana*.

Pollen fertility. *Rosa acicularis*, $n = 21$, × *Rosa nutkana*, $n = 21$: highly fertile F1 (Erlanson, 1934).

4a. Rosa ×engelmannii S. Watson nothosubsp. **engelmannii** [*Rosa acicularis* Lindl. subsp. *sayi* (Schwein.) W. H. Lewis × *Rosa nutkana* C. Presl subsp. *melina* (Greene) W. H. Lewis & Ertter].

Stems densely acicular at base as in *Rosa acicularis* and sometimes extending upward; some infrastipular prickles present as in *R. nutkana* subsp. *melina*; hypanthium with distinct neck; sepals occasionally upright, stipitate glandular with entire margins.

Vernacular name. Engelmann's rose.

Distributions known. *Rosa* ×*engelmannii* nothosubsp. *engelmannii* is found in Colorado, Michigan, Montana, New Mexico, South Dakota, and Wyoming in the United States. There is shared distribution of both parental taxa in Colorado and Wyoming.

Representative specimens. U.S.A. **Colorado:** Chaffee Co., W. S. Marshall Pass, 20 Aug. 1901, *C. F. Baker 1901* (MO); Fremont Co., Lake Creek, 4 mi. W of hill side, 5500 ft., 12 July 1925, *E. W. Erlanson 1518* (MICH, MO); Gilpin Co., Roosevelt Natl. Forest, W of Rollinsville, 25 Aug. 2005, *R. M. King & R. M. Garvey 14023* (MO); Rocky Mtn., Estes Park Co., Larimer, 3 July 1912, *J. R. Churchill s.n.* (MO); headwaters of Clear Creek, 1861, *C. C. Parry s.n.* (MO; ref. Lewis, 2012); Larimer Co., 3 air mi. W of Fort Collins, 3

Aug. 2001, *S. Nunn 4427* (RM); Quigley, 7 Apr. 1965, *C. B. Davis s.n.* (MO). **Michigan:** Washtenaw Co., Ann Arbor, 8 Sep. 1966, *W. H. Lewis 2529* (MICH, MO). **Montana:** Flathead Co., Flathead Lake & vic., Swan Lake, 25 Aug. 1908, *Mrs. J. Clemens s.n.* (PH); Missoula Co., 5 mi. N of Missoula, along Rattlesnake Creek, 18 June 1966, *W. H. Lewis 6763* (DAO, MO, UC). **New Mexico:** Santa Fe Co., Santa Fe, 6 Aug. 1910, *E. O. Wooton s.n.* (US). **South Dakota:** Black Hills Co., Custer, 19 Aug. 1892, *P. A. Rydberg 676* (K). **Wyoming:** Albany Co., near Centennial, 15 July 1922, 8500 ft., *C. H. Kauffman & C. O. Erlanson 3* (MO); Carbon Co., Medicine Bow Mtns., 1923, *B. B. Kanouse 3722* (MICH, MO).

4b. Rosa ×engelmannii S. Watson nothosubsp. **britannicae-columbiae** W. H. Lewis, nothosubsp. nov. [*Rosa acicularis* Lindl. subsp. *sayi* (Schwein.) W. H. Lewis × *Rosa nutkana* C. Presl subsp. *macdougalii* (Holz.) Piper]. TYPE: Canada. British Columbia: West Kettle River Valley, Rock Creek, 19 Aug. 1953, *V. J. Krajina s.n.* (holotype, UBC [V79643]; isotype, UBC [V79644]). Figure 6.

Haec nothosubspecies inter parentes *Rosam acicularem* Lindl. subsp. *sayi* (Schwein.) W. H. Lewis et *R. nutkanam* C. Presl subsp. *macdougalii* (Holz.) Piper intermedia, sed a hac foliolis terminalibus marginibus dentato-serratis atque sepalis erectis conniventibus hypanthii fructiferi ad apicem rostrum formantibus, ab illa caulibus aculeis infrastipularibus paucis remotis armatis atque foliolis interdum acute serratis distinguitur.

Stems armed with few scattered infrastipular prickles without aciculae, some leaflets with sharply serrate margins as in *Rosa nutkana* subsp. *macdougalii*; sepals clasping and upright to form groups (beak caps) on urceolate hips, terminal leaflet margins dentate-serrate as in *R. acicularis* subsp. *sayi*.

Etymology. *Rosa ×engelmannii* subsp. *britannicae-columbiae* is named for the province of British Columbia, where my early *Rosa* education at the University of British Columbia led to my lifetime study of *Rosa* in North America.

Vernacular name. British Columbia rose.

Distribution. *Rosa ×engelmannii* subsp. *britannicae-columbiae* is found in British Columbia in Canada, and in Montana and Washington in the United States (Rydberg, 1918; Hultén, 1968). There is shared distribution of both parental taxa in British Columbia in Canada, and in Colorado, Montana, and Wyoming in the United States.

Paratypes. CANADA. **British Columbia:** Barkerville, 7 Aug. 1954, *J. A. Calder et al. 14210* (DAO, UBC); Burns Lake, 6 Sep. 1951, *W. H. Lewis 1266* (MO, UBC); Cinema, 18 June 1952, *T. M. C. Taylor & W. H. Lewis 230* (MO, UBC); Eaglet Lake, 20 June 1952, *T. M. C. Taylor & W. H. Lewis 233* (MO, UBC); Kinbasket Lake, 17 Aug. 1953, *A. Calder & D. B. O. Savile 11967* (DAO, UBC); Prince George, 8 Sep. 1951, *W. H. Lewis 1272* (MO); Thompson–Okanogan, Pavlick, 14 Sep. 1989, *E. Leon 89-266* (UBC, V); 5 mi. E of Perow, 23 June 1952, *T. M. C. Taylor & W. H. Lewis 248* (MO, UBC); Vanderhoof, 2 July 1954, *J. A. Calder et al. 12343* (DAO, UBC); Windermere, 12 mi. NE, 9 July 1958, *R. L. Taylor & D. H. Ferguson 2590* (DAO, UBC); about 2 mi. S of Avola on Hwy. 5, 25 June 1971, *W. H. Lewis 7761* (MO).

U.S.A. **Montana:** Flathead Co., Flathead Lake, 18 July 1908, *Mrs. J. Clemens s.n.* (GM, MONT); Lewis & Clark Co., Helena, 28 July 1908, *B. T. Butler 819* (NY, UBC); Saunders Co., Hot Springs, 24 June 1956, *W. E. Booth 56641* (GH); 24 July 1956, *W. E. Booth s.n.* (GH), **Washington:** Spokane Co., Spokane, 13 July 1930, *E. J. Palmer 37840* (MO).

4c. Rosa ×engelmannii S. Watson nothosubsp. **occidentalis** W. H. Lewis, nothosubsp. nov. [*Rosa acicularis* Lindl. subsp. *sayi* (Schwein.) W. H. Lewis × *Rosa nutkana* C. Presl. subsp. *nutkana*.] TYPE: Canada. British Columbia: Lake Okanogan, Naramata, ca. 1915, *J. K. Henry s.n.* (holotype, UBC).

Haec nothosubspecies inter parentes *Rosam acicularem* Lindl. subsp. *sayi* (Schwein.) W. H. Lewis et *R. nutkanam* C. Presl subsp. *nutkanam* intermedia, sed a hac aculeis brevioribus, foliolis uniserratis atque hypanthio in collum desinente, ab illa aculeis infrastipularibus praesentibus distinguitur.

Stems densely aciculate, often to apex, elongate; infrastipular prickles present as in *Rosa nutkana* subsp. *nutkana*; hypanthia ellipsoid with necks; leaves typical of *R. acicularis* subsp. *sayi*. Considered more toward *R. acicularis*.

Vernacular name. Western rose.

Distribution. *Rosa ×engelmannii* nothosubsp. *occidentalis* is found in British Columbia in Canada, and in Alaska and Montana in the United States. There is shared distribution of both parental taxa in British Columbia and Northwest Territories in Canada, and in Alaska in the United States.

Paratypes. U.S.A. **Alaska:** municipality of Anchorage, 17 air mi. SE of "The Grotto," 23 Aug. 2014, *B. Ertter 221162 & V. Pratt* (ALA, MO). **Montana:** Missoula Co., Rattlesnake Bottoms, 7 Aug. 2012, *J. E. Kirkwood 1179* (MO, MONT).

5. Rosa ×fernaldiorum W. H. Lewis, nothosp. nov. [*Rosa carolina* L. × *Rosa nitida* Willd.]. TYPE:

Figure 6. *Rosa ×engelmannii* S. Watson nothosubsp. *britannicae-columbiae* W. H. Lewis. Holotype, *Krajina s.n.* (UBC).

U.S.A. Maine: Piscataquis Co., Foxcroft, 1896, *G. B. Fernald s.n.* (holotype, GH).

Haec nothospecies inter parentes *Rosam carolinam* L. et *R. nitidam* Willd. intermedia, sed a hac aculeis stipularibus crassioribus, ab illa florum forma magnitudineque distinguitur.

Stems with mix of densely setigerous prickles typical of *Rosa nitida*, with floral branches having

paired, stout infrastipular prickles typical of *R. carolina*, rarely calcite. Leaf blades narrowly elliptic, margins 1-serrate (as in *R. nitida*) or 2-serrate (as in *R. carolina*). Stipules of *R. carolina*. Floral branches have fine prickles, and the stipules are very stout. Inflorescences are commonly multifarious, to 3. Pedicels are erect, stipitate glandular to 25 mm. Flowers to 5.5 cm diam., hypanthium densely stipitate glandular, globose, no neck (*R. nitida*). Hips globose, densely stipitate glandular, hypanthium globose-ovoid, sparsely stipitate glandular, small neck 0.5–2 mm; sepals reflexed, mostly eglandular.

Etymology. *Rosa* ×*fernaldiorum* honors the eminent Fernalds who contributed greatly to the understanding of the flora and fauna of northeastern North America, and most particularly the collector of the type, George Bancroft Fernald.

Vernacular name. Fernald's rose.

Distribution. *Rosa* ×*fernaldiorum* is found in Maine in the United States. There is shared distribution of both parental taxa in New Brunswick, Nova Scotia, Ontario, and Prince Edward Island in Canada, and in Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont in the United States.

Discussion. *Rosa* ×*fernaldiorum* is an outstanding hybrid exhibiting vegetative characteristics of both parents; flowers resemble *R. nitida*. François Crépin, a Belgian rhodologist who contributed greatly to the early understanding of *Rosa* in North America (Crépin 1896), was the first author to report hybridization of *R. carolina* × *R. nitida* (Crépin, 1900).

Paratype. U.S.A. **Maine:** Hancock Co., Hadlock Pond, Mt. Desert Island, 1 Sep. 1988, *J. H. Redfield 2665* (MO).

6. Rosa ×gilmaniana W. H. Lewis, nothosp. nov. [*Rosa blanda* Aiton × *Rosa carolina* L.]. TYPE: U.S.A. Vermont: Addison Co., Button Island, Ferrisburg, 26 June 1981, *P. F. Zika 3778* (holotype, VT).

Haec nothospecies inter parentes *Rosa blandam* Aiton et *R. carolinam* L. intermedia, sed a hac foliolis marginibus subserratis usque uniserattis abaxialiter hebetates sublustrosisve atque hypanthio fructifero plerumque globoso eglanduloso vel parce stipitato-glanduloso; ab illa petalis 17–25 mm longis distinguitur.

Stems with scattered infrastipular prickles, rarely internodal or aciculi. Leaves 5–9 cm; leaflet margins subserrate to 1-serrate, abaxial surfaces dull to somewhat lustrous. Pedicels erect, 5–20 mm, with few long-stipitate glands or none; flowers with hypanthia oval or globose, with few long-stipitate glands or none; sepals lanceolate to ovate lanceolate, deciduous; petals 17–25 mm in *Rosa carolina*; hips mostly globose, eglandular or sparsely stipitate glandular as in *R. blanda*.

Etymology. *Rosa* ×*gilmaniana* is named for Arthur V. Gilman, author of *Flora of Vermont* and distinguished collector of *Rosa* and other taxa in Vermont and New England, with many collections provided to MO.

Vernacular name. Gilman's rose.

Distribution. *Rosa* ×*gilmaniana* is found in Ontario in Canada, and in Maine, Massachusetts, Michigan, New Hampshire, New York, Vermont, and Wisconsin. There is shared distribution of both parental taxa in New Brunswick, Nova Scotia, Ontario, and Quebec in Canada, and in Illinois, Indiana, Iowa, Maine, Massachusetts, Michigan, Missouri, Nebraska, New Hampshire, New York, Ohio, Pennsylvania, Rhode Island, Vermont, West Virginia, and Wisconsin in the United States.

Pollen fertility. *Rosa blanda*, $n = 7$ × *Rosa carolina*, $n = 14$: highly sterile F1 (Erlanson, 1934).

Paratypes. CANADA. **Ontario:** Essex Co., Lake Erie, Pelee Island, W Alvar, East–West Rd. at Stone Rd., 25 June 2006, *M. J. Oldham 32869* (MO); Essex Co., Pelee Island, Krestel Property (now Nature Conservancy of Canada), N side of East–West Rd. at Stone Rd., 16 June 2010, *M. J. Oldham & S. R. Brinker 37381* (MO).

U.S.A. **Maine:** Piscataquis Co., Dover, Piscataquis River valley, 26 June 1895, *M. L. Fernald 234A* (GH); 7 Aug 1894, *M. L. Fernald 234B* (GH); Knox Co., Camden, Mt. Megunticook, 13 Aug. 1913, *A. H. Norton 9314* (NHA). **Massachusetts:** Berkshire Co., Lanesboro, 18 July 1917, *J. R. Churchill s.n.* (MO); Bristol Co., Dighton, 21 June 1961, *F. C. Seymour 19239* (MO). **Michigan:** Cheboygan Co., Douglas, 18 Aug. 2004, *W. H. Lewis & M. P. F. Elvin-Lewis 15887* (MO); Washtenaw Co., Ann Arbor, University of Michigan Botanical Garden, 8 Sep. 1955, *E. W. Erlanson 13361* (MICH, MO). **New Hampshire:** Cheshire Co., Walpole by Connecticut River, W slope of Fall Mtn., 30 July 1900, *H. M. Noyes & M. L. Fernald* 347 (VT). **New York:** Tompkins Co., Ithaca, 8 Sep. 1955, *E. W. Erlanson 2949* (MICH, MO). **Vermont:** Addison Co., Ferrisburg, Button Point, Lake Champlain, 24 June 1983, *P. F. Zika 7165* (VT); Chittenden Co., Colchester, above Winooski River betw. Twin Bridges & High Bridge, 29 June 1983, *P. F. Zika 7308* (VT); Orange Co., Fairlee palisades, 8 July 1927, *M. E. Mathias 141* (MO). **Wisconsin:** La Crosse Co., Dutch Creek, 2 June 1894, *J. H. Schuette* (US).

7. Rosa ×hainesii W. H. Lewis, nothosp. nov. [*Rosa blanda* Aiton × *Rosa virginiana* Mill.]. TYPE:

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HERBARIUM
№ 6080729
MISSOURI BOTANICAL GARDEN
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0 1 2 3 4 5 6 7 8 9 10 cm
UNITED STATES
ROSACEAE
Rosa virginiana ? Mill.
det. W. H. Lewis (MO), 2008
Maine: Somerset County
By Skowhegan, Kennebec River at Great Eddy, 12 m NW upstream of #21135, growing in calcareous rocky shale.
44°46'17"N 069°42'13"W 160 ft
Shrubs in deep shade of alders and birches, rhizomatous to 0.75 m tall; all hips aborting, growing in calcareous rocky shale (living material collected).
13 July 2008
W.H. Lewis & A. Haines 21136
MISSOURI BOTANICAL GARDEN HERBARIUM (MO)
(Walter H. Lewis & A. Haines 21136)
ROSACEAE [126]
Rosa × hainesii W.H. Lewis
det. Walter H. Lewis (MO), 2015

Figure 7. *Rosa ×hainesii* W. H. Lewis. Holotype, *W. H. Lewis & A. Haines 21136* (MO).

U.S.A. Maine: Somerset Co., by Skowhegan, Kennebec River at Great Eddy, 13 July 2008, *W. H. Lewis & A. Haines 21136* (holotype, MO). Figure 7.

Haec nothospecies inter parentes *Rosa blandam* Aiton et *R. virginianam* Mill. intermedia, sed a hac hypanthiis glandulis stipitatis paucis vel nullis, ab illa sepalis longioribus lanceolatis distinguitur.

Upper branches of stem without prickles or with very few aciculi; leaf blades broadly ovate, leaflets glabrous; hypanthia with stipitate glands few or lacking as in *Rosa blanda*; stipules with few or lacking stipitate glands; some sepals pinnatifid, majority entire. Sepals long, lanceolate as in *R. virginiana*.

Etymology. *Rosa ×hainesii* is named for Arthur Haines, author of *Flora Novae Angliae* (2011), a brilliant botanical book covering New England and eastern North America.

Vernacular name. Haines' rose.

Distribution. *Rosa ×hainesii* is found in Nova Scotia and Ontario in Canada, and in Maine, Massachusetts, New York, and New Hampshire in the United States. There is shared distribution of both parental taxa in New Brunswick, Nova Scotia, Ontario, and Quebec in Canada, and in Maine, Massachusetts, Michigan, New Hampshire, New York, Pennsylvania, and Rhode Island in the United States.

Pollen fertility. *Rosa blanda*, $n = 7$, × *Rosa virginiana*, $n = 14$: highly sterile F1 (Erlanson, 1934).

Paratypes. CANADA. **Nova Scotia:** Cape Breton, Aspy Bay, Mountain Rd., 28 July 1909, *J. R. Churchill s.n.* (MO). **Ontario:** Co. Essex, Pelee Island, Stone Rd. Alvar, 25 June 2006, *M. J. Oldham 32860* (MO, personal herbarium of M. J. Oldham [MJO]); Point Abino, Lake Erie, 28 Aug. 1896, *J. K. Small s.n.* (MO).

U.S.A. **Maine:** Aroostook Co., Caribou, shore of Aroostook River near May Rd., 3 July 2003, *A. V. Gilman 03021* (MO, VT); Penobscot Co., Bradley, N of Government Rd., Blackman Stream, 5 Sep. 2003, *A. V. Gilman 03106* (MO); Pisataquis Co., Orono, Bangor bog, *G. B. Fernald 2958* (GH); Piscataquis Co., Foxcraft, *M. L. Fernald 161* (GH); Dover, 26 July 1894 (fl.) & 7 Aug. 1895 (fr.), *M. L. Fernald 234* (MO); Sagadahoc Co., Bowdoinham, jct. Cathance River & Rte. 24 by bridge, Summerset Co. by Skowhegan, Larone Rd., 25 July 2008, *L. H. Coburn s.n.* (MO); Sagadahac Co., Bowdoinham, jct. Cathance River & Rte. 24, 12 July 2008, *W. H. Lewis & A. Haines 21129* (MO). **Massachusetts:** Bristol Co., Dighton, along Segreganet River, 1 July 1957, *F. Seymour 17160* (MO). **New Hampshire:** Coos Co., Stark, 6 July 1950, *A. S. Pease 35339* (GH); Pike pond, *A. S. Pease 23778* (GH); Peterborough Co., Peterborough, 3 Sep. 1927, *C. F. Batcheler s.n.* (MO); Cheshire Co., Walpole, Connecticut River, 4 Sep. 1887, *J. R. Churchill s.n.* (MO). **New York:** Onondaga Co., Green Lakes State Park, 2 July 1954, *W. H. Lewis 2180* (MO).

8. Rosa ×harmsiana W. H. Lewis, nothosp. nov. [*Rosa acicularis* Lindl. × *Rosa arkansana* Porter]. TYPE: Canada. Ontario: Elgin Co., West Lorne Woods, Kerr Rd. at abandoned railway tracks (probably via railway), lat: 42.58517554, long: −81.64426282, 10 m, flowering, small patch, 15 June 2010, *M. J. Oldham & S. R. Brinker 37367* (holotype, MO; isotype, DAO). Figure 8.

Haec nothospecies inter parentes *Rosam acicularem* Lindl. et *R. arkansanam* Porter intermedia, sed a hac hypanthio oblongoideo in collum desinente, ab illa inflorescentia 8-flora distinguitur.

Leaflets to 9; sepals glandular; hypanthia oblong with neck as in *Rosa acicularis*, inflorescence 8-flowered as in *R. arkansana*.

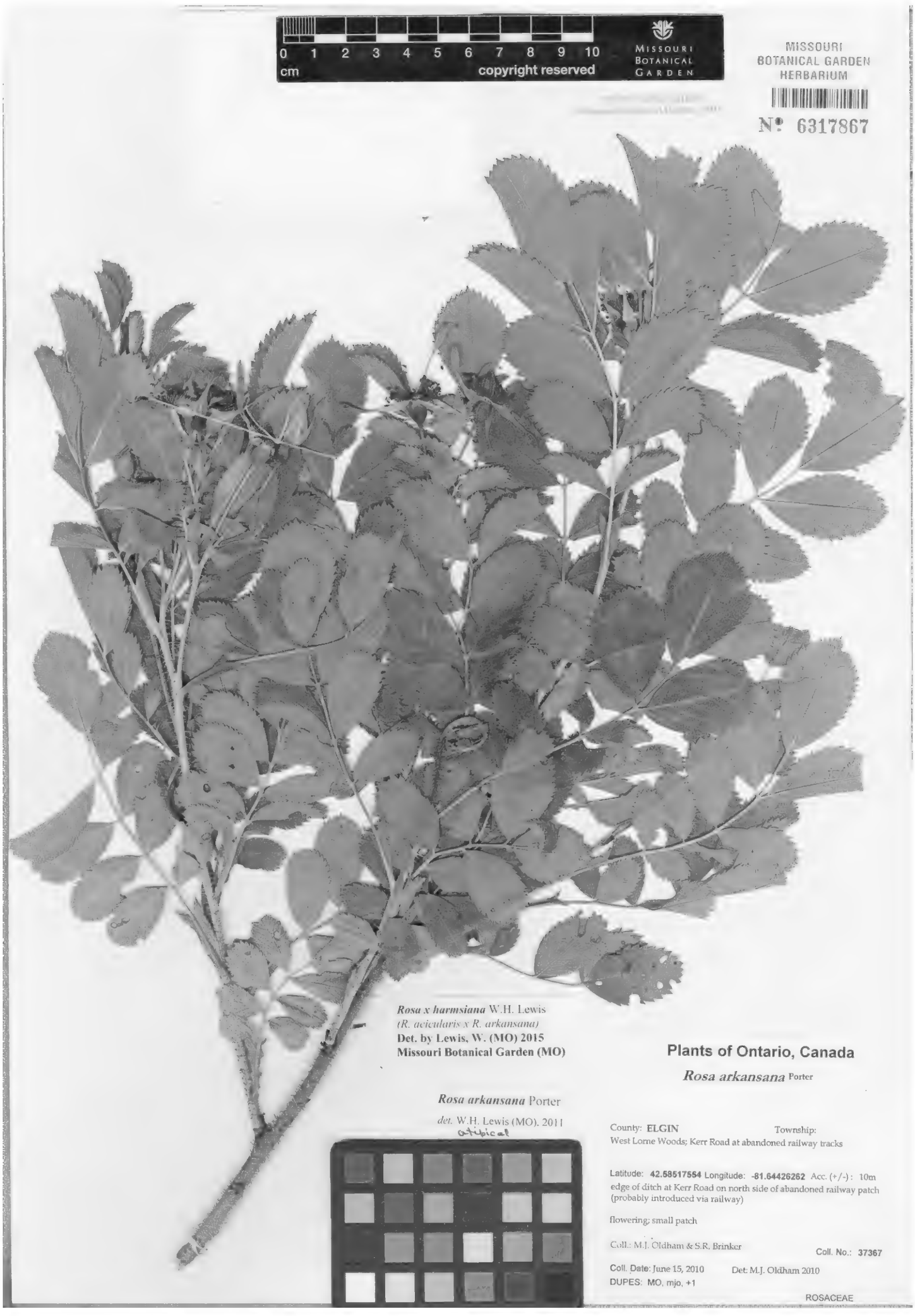
Etymology. *Rosa ×harmsiana* is dedicated to Dr. V. L. Harms, professor emeritus, University of Saskatchewan and former director of the Fraser Herbarium. His deep interest in *Rosa* of the Canadian prairies, particularly Saskatchewan, is clearly illustrated by his paper (Harms, 1974).

Vernacular name. Harms' rose.

Distribution. *Rosa ×harmsiana* is found in Alberta, Manitoba, Northwest Territories, Ontario, and Saskatchewan in Canada, and in Minnesota in the United States. There is shared distribution of both parental taxa in Alberta, British Columbia, Manitoba, Ontario, and Saskatchewan, Canada, and in Colorado, Iowa, Maine, Michigan, Minnesota, New Hampshire, New York, North Dakota, South Dakota, Vermont, Wisconsin, and Wyoming in the United States.

Discussion. A plant resembling *Rosa ×harmsiana* was photographed by Thomas Dewlen in June 2013 near Medaryville in Pulaski Co., Indiana. The plant was described as follows: "having 5–9 leaflets; mostly seven, deeper pink flowers somewhat cupped, born singly, or in pairs with hips long and narrow unlike other *Rosa* nearby, sepals very long and narrow, thorns straight with some bristles with a few on the back of leaves and a less pungent fragrance." It was discovered growing on the roadside at the edge of dry prairie remnant in sandy environment near marsh among other wild rose species, and might have been introduced through waterways from the North. The description fits that of this nothospecies, and the plant is considered a possible hybrid, but because of subsequent herbicide use no voucher or living specimen could be obtained retrospectively.

Pollen fertility. *Rosa arkansana*, $n = 14$, × *Rosa acicularis*, $n = 21$: semi-fertile F1 (Erlanson, 1934).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Missouri Botanical Garden
MISSOURI BOTANICAL GARDEN HERBARIUM
Nº 6317867
Rosa x harmsiana W.H. Lewis
(R. acicularis x R. arkansana)
Det. by Lewis, W. (MO) 2015
Missouri Botanical Garden (MO)
Plants of Ontario, Canada
Rosa arkansana Porter
Rosa arkansana Porter
det. W.H. Lewis (MO). 2011
atypical
County: ELGIN
Township:
West Lorne Woods; Kerr Road at abandoned railway tracks
Latitude: 42.58517554 Longitude: -81.64426262 Acc. (+/-): 10m
edge of ditch at Kerr Road on north side of abandoned railway patch
(probably introduced via railway)
flowering; small patch
Coll.: M.J. Oldham & S.R. Brinker
Coll. No.: 37367
Coll. Date: June 15, 2010
Det: M.J. Oldham 2010
DUPES: MO, mjo, +1
ROSACEAE

Figure 8. *Rosa* ×*harmsiana* W. H. Lewis. Holotype, *M. J. Oldham & S. R. Brinker 37381* (MO).

Paratypes. CANADA. **Alberta:** 4 mi. W Banff Natl. Park, 1 Aug. 1956, *F. J. Hermann 13249* (MO); Edmonton, N Saskatchewan River, 17 July 1984, *J. Meldrum 21* (ALTA); S Porcupine Hills, roadside, 12 Aug. 1982, *J. Campbell-Snelling & M. Chambers 1163* (ALTA). **Manitoba:** near Emerson, 12 July 2000, *M. J. Oldham 24166* (DFB, MICH, MO); 20 mi. NE of Winnipeg, Sandilands Forest Reserve, 14 July 1949, *A. J. Breitung 7921* (MO). **Saskatchewan:** Edmonton, Prairie Point, above N Saskatchewan River, 17 July 1984, *J. Meldrum 21* (ALTA); S Porcupine Hills, 12 Aug. 1982, *J. Kuijt, Campbell-Snelling & M. Chambers 1163* (ALTA, LEA); vic. of Lloydminster,

26. Aug. 1953, *W. H. Lewis 1562* (MO); SW of Saskatoon, Pike Lake Prov. Park, 28 July 1973, *J. D. Shorthouse 11A* (SASK), S Saskatoon, Cranberry Flats, above Saskatchewan River, 10 Oct. 2006, *W. H. Lewis & M. Elvin-Lewis 21049* (MO), and material from that collection propagated in Missouri, 29 May 2008, *W. H. Lewis 21183* (MO).

U.S.A. **Minnesota:** Sherburne Co., Elk River, 15 July 1886, *L. H. Bailey Jr. s.n.* (MO).

9. Rosa ×hodgdonii W. H. Lewis, nothosp. nov. [*Rosa nitida* Willd. × *Rosa virginiana* Mill.]. TYPE: Canada. New Brunswick: Charlotte Co., Pennfield Parish, East Wolf Island, 18 June 1961, *A. R. Hodgdon & R. B. Pike 18021* (holotype, NHA).

Rosa nitida f. *spinosa* W. H. Lewis, syn. nov. TYPE: U.S.A. Maine: Franklin Co., Pease Pond, East Wilton, Sandy River Valley, 11 Aug. 1894, *M. L. Fernald s.n.* (holotype, GH).

Haec nothospecies inter parentes *Rosa nitidam* Willd. et *R. virginianam* Mill. intermedia, sed a hac pedicellis ad apicem hypanthiis sicut sepalisque glandulis stipitatis longis dense vestitis, ab illa aculeis saepe curvatis distinguitur.

Stems with short infrastipular and internodal prickles together with longer, thicker, and enlarged prickles at the base densely mixed with aciculi, prickles often curved as those in *Rosa virginiana*; hypanthia, upper pedicels, and sepals densely covered with long stipitate glands resembling those of *R. nitida*.

Etymology. The nothospecies is named for Albion R. Hodgdon, former professor and herbarium director, University of New Hampshire, where the herbarium was named in his honor in 1978.

Vernacular name. Hodgdon's rose.

Distribution. *Rosa ×hodgdonii* is found in St. Pierre and Miquelon, New Brunswick, Newfoundland, Nova Scotia, Ontario, Prince Edward Island, and Quebec in Canada, and in Maine, Massachusetts, and New York in the United States. There is shared distribution of both parental taxa in St. Pierre and Miquelon, New Brunswick, Newfoundland, Nova Scotia, Ontario, Prince Edward Island, and Quebec in Canada, and in Connecticut, Maine, Massachusetts, New Hampshire, New York, and Rhode Island in the United States.

Discussion. The hybrid *Rosa nitida* Willd. × *R. virginiana* Mill. was recognized by Rydberg (1918). In 1958, *R. nitida* f. *spinosa* W. H. Lewis was published to replace Rydberg's *R. nitida* Willd. × *R. virginiana* Mill., in synonymy (Lewis, 1958b). *Rosa nitida* f. *spinosa* is now also placed in synonymy.

Pollen fertility. *Rosa nitida*, $n = 7$ × *Rosa virginiana*, $n = 14$: highly sterile F1 (Erlanson, 1934).

Paratypes. CANADA. **Newfoundland:** Bay St. George, 5–7 Aug. 1901, *Howe & Lang 1002* (GH). **Quebec:** Vallée du Richelieu, Chambly, comté de Chambly, le long du Richelieu, 26 June 1932, *F. Marie-Victorin & F. Rolland-Germain 46304* (MO, MT).

U.S.A. **Maine:** Lincoln Co., G. Jefferson, Cooper Mills, l July 1934, *F. Hyland 112* (MAINE); Knox Co., Isle au Haut, 29 July 1919, *N. T. Kidder s.n.* (NHA); Isle au Haut, Deval's Dam, 24 Aug. 1923, *N. T. Kidder s.n.* (NHA); Isle au Haut, Bom Beach, 11 July 1968, *D. A. Wise 69* (NHA). **Massachusetts:** Dukes Co., Martha's Vineyard, 8 Aug. 1927, *J. A. Drushel 6262* (MO). **New Hampshire:** Coos Co., Pike pond, *A. S. Pease 23778* (GH); Rockingham Co., Nottingham, 30 July 1956, *A. R. Hodgdon 9662* (NHA).

10. Rosa ×massiana W. H. Lewis, nothosp. nov. [*Rosa carolina* L. × *Rosa rugosa* Thunb.]. TYPE: U.S.A. Massachusetts: Essex Co., Crane's Beach, near Ipswich via Argilola Rd., 20 June 2002, *S. Joly & J. R. Starr 465* (holotype, MT). Figure 9.

Haec nothospecies inter parentes *Rosa carolinam* L. et *R. rugosam* Thunb. intermedia, sed ab illa hypanthio sepalis pedicellisque dense stipitato-glandulosis distinguitur.

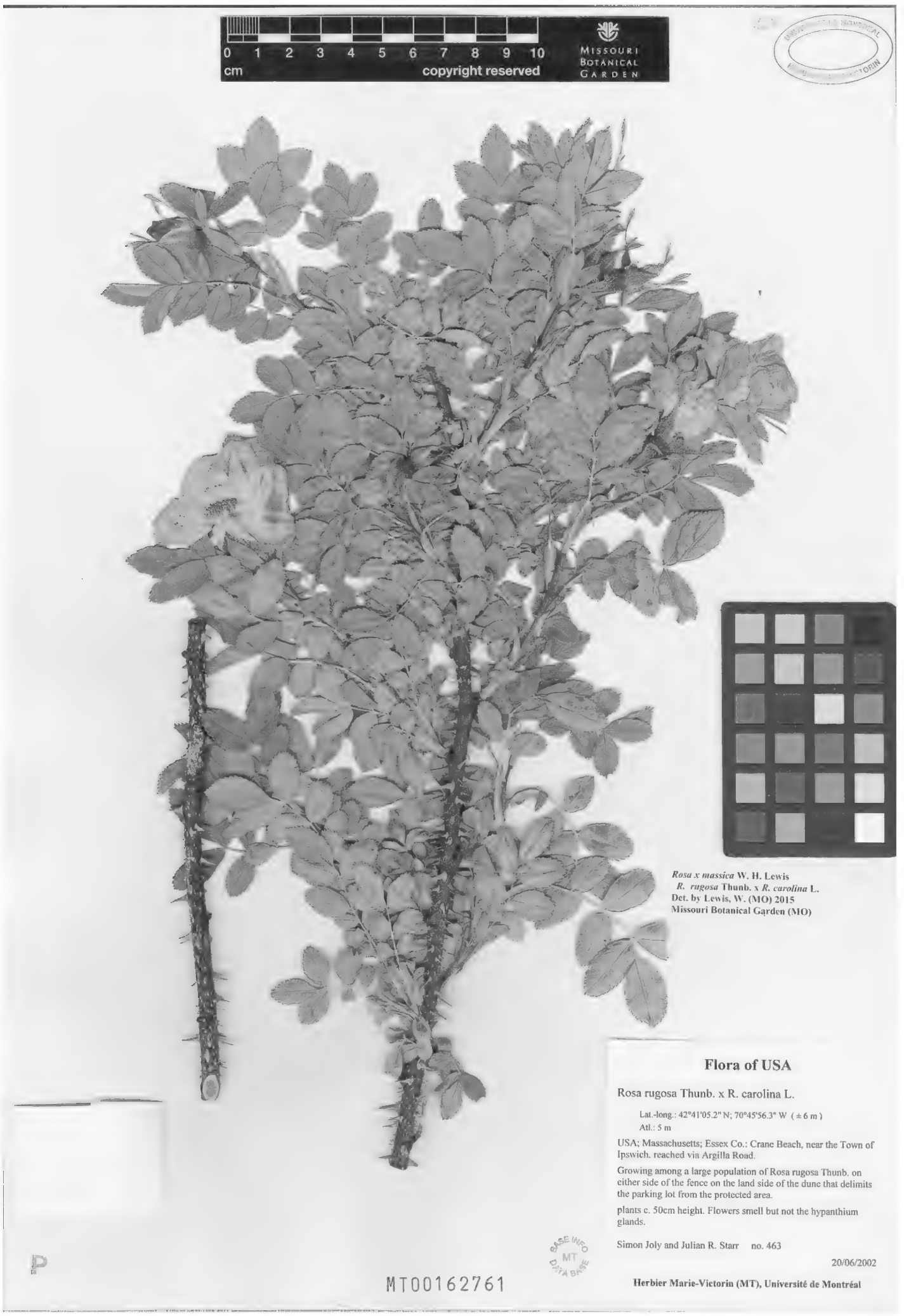
Intermediate between *Rosa carolina* and *R. rugosa*; leaflets elliptic; hypanthia, sepals, and pedicels densely stipitate glandular, as in *R. rugosa*.

Etymology. *Rosa ×massiana* is named for the state of Massachusetts, where many taxa of *Rosa* occur.

Vernacular name. Massachusetts rose.

Distribution. *Rosa ×massiana* is found in Massachusetts in the United States. There is shared distribution of both parental taxa in New Brunswick, Nova Scotia, Ontario, Prince Edward Island, and Quebec in Canada, and in Connecticut, Delaware, Illinois, Maine, Maryland, Massachusetts, Michigan, Missouri, New Hampshire, New Jersey, New York, Ohio, Pennsylvania, Rhode Island, Vermont, Virginia, and West Virginia in the United States.

11. Rosa ×oldhamii W. H. Lewis, nothosp. nov. [*Rosa arkansana* Porter × *Rosa woodsii* Lindl.]. TYPE: Canada. Ontario: Kent Co., 2 km W of Tupperville, beach, betw. rd. & railway, 14 Aug. 1997, *M. J. Oldham 20345* (holotype, MO; isotypes, MICH, MJO). Figure 10.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Missouri Botanical Garden
Rosa x massica W. H. Lewis
R. rugosa Thunb. x R. carolina L.
Det. by Lewis, W. (MO) 2015
Missouri Botanical Garden (MO)
Flora of USA
Rosa rugosa Thunb. x R. carolina L.
Lat.-long.: 42°41'05.2" N; 70°45'56.3" W (± 6 m)
Atl.: 5 m
USA; Massachusetts; Essex Co.: Crane Beach, near the Town of Ipswich. reached via Argilla Road.
Growing among a large population of Rosa rugosa Thunb. on either side of the fence on the land side of the dune that delimits the parking lot from the protected area.
plants c. 50cm height. Flowers smell but not the hypanthium glands.
Simon Joly and Julian R. Starr no. 463
20/06/2002
Herbier Marie-Victorin (MT), Université de Montréal
MT00162761

Figure 9. *Rosa* ×*massiana* W. H. Lewis. Holotype, *S. Joly & J. R. Starr 465* (MT).

Haec nothospecies inter parentes *Rosam arkansanam* Porter et *R. woodsii* Lindl. intermedia, sed a hac hypanthio fructifero stipitato-glanduloso atque foliolis plerumque 9, ab illa caulibus foliolisque aculeis brevibus gracilibus armatis distinguitur.

Separated, branched stems, having paired infrastipular prickles (typical of *Rosa woodsii*) and short, thin prickles on stems and leaves; leaflets usually 9, less often 7; flowers in terminal clusters typical of *R.*

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MISSOURI BOTANICAL GARDEN
Rosa x oldhamii W. H. Lewis
(R. arkansana x R. woodsii ssp. woodsii)
Det. by Lewis, W. (MO) 2015
Missouri Botanical Garden (MO)
Type of: Rosa x oldhamii W.H. Lewis
Ref.
Missouri Botanical Garden (MO)
Plants of Ontario, Canada
Rosa arkansana Porter
County: KENT
ca. 2km W of Tupperville
Latitude: 42.59013 Longitude: -82.29554 Acc. (+/-):
ditch between road and railway tracks
"Prob. OK. Vegetative,but lflts mostly 9,underside soft-pubescent,+/-
obovate; twigs thickish, glaucous bloom"-AAR
Coll.: M.J. Oldham
Coll. No.: 20345
Coll. Date: August 14, 1997
Det: M.J. Oldham, !A.A. Reznicek Feb. 2004 (cf.)
DUPES: MICH, mjo, MO
ROSACEAE

Figure 10. *Rosa* ×*oldhamii* W. H. Lewis. Holotype, *M. J. Oldham 20345* (MO).

arkansana; hips stipitate glandular (found occasionally only in *R. arkansana*).

Etymology. *Rosa* ×*oldhamii* honors Michael J. Oldham, Director of the Ontario Natural Heritage Information Centre (NHIC). Mr. Oldham obtained an understanding of *R. woodsii* and *R. arkansana* in eastern distributions while providing relevant collections, including the type of this nothotaxon, to MO.

Vernacular name. Oldham's rose.

Distribution. *Rosa* ×*oldhamii* is found in Alberta, and Ontario in Canada, and in Kansas in the United States. There is shared distribution of both parental taxa in Alberta, British Columbia, Manitoba, Ontario, and Saskatchewan in Canada, and in Colorado, Iowa, Kansas, Minnesota, Montana, Nebraska, New Mexico, North Dakota, Ohio, Oklahoma, South Dakota, Texas, and Wyoming in the United States.

Discussion. *Rosa* ×*oldhamii* is named as a nothospecies, so the parental taxa are formally specified only to the species level. However, only *R. woodsii* subsp. *woodsii* occurs in the appropriate range to be its parent.

Pollen fertility. *Rosa woodsii*, $n = 7$, × *Rosa arkansana*, $n = 14$: highly sterile F1 (Erlanson, 1934).

Paratypes. CANADA. **Alberta:** Fort Saskatchewan, 24 Sep. 1938 (leaves) & Oct. (fruit/stems), *G. H. Turner s.n.* (ALTA); Mulhurst, 4 July 1957, *G. H. Turner 9498* (WHY).

U.S.A. **Kansas:** Miami Co., Hillsdale, 5 Aug. 1954, *W. H. Lewis 2388* (MO).

12. Rosa ×per-axeliana W. H. Lewis, nothosp. nov. [*Rosa acicularis* Lindl. × *Rosa blanda* Aiton]. TYPE: Canada. Ontario: Rainy River Co., Sable Island Provincial Nature Reserve, SE of Lake of the Woods, 48.88805°N, 94.67459°W, 29 June 2008, flowering, common on dunes, *M. J. Oldham, S. Brinker & W. D. Bakowsky 35642* (holotype, MO). Figure 11.

Haec nothospecies inter parentes *Rosam acicularem* Lindl. et *R. blandam* Aiton intermedia, sed ab illa cortice in juventute viridi in aetate rubro aurantiacove, aciculis distalibus plerumque carentibus atque petiolorum aculeis nullis distinguitur.

Stem armature with dense, short prickles and aciculi, density decreasing greatly to apex. Leaf auricles erect or flared, leaflets often mixed with 1-serrate and 2-serrate margins, numerous teeth. Pedicels reflexed with floral maturity. Hypanthia typically oblong or urceolate with neck. Leaning to *Rosa acicularis*. Similar to *R. blanda* with green bark when young, red to orange with age, distal aciculi mostly absent, petiole prickles absent.

Etymology. *Rosa* ×*per-axeliana* is named in honor of Per Axel Rydberg, 1860–1931, distinguished Swedish/American botanist, taxonomist at New York Botanical Garden, perhaps best known for the North American Flora of 1918 and the Floras of Colorado and Rocky Mountains.

Vernacular name. Per Axel's rose.

Distribution. *Rosa* ×*per-axeliana* is found in Alberta, Manitoba, Northwest Territories, Ontario, and Saskatchewan in Canada, and in Minnesota in the United States. There is shared distribution of both parental taxa in Manitoba, New Brunswick, Northwest Territories, Nova Scotia, Ontario, Quebec, and Saskatchewan in Canada, and in Iowa, Maine, Massachusetts, Michigan, Minnesota, New Hampshire, New York, North Dakota, South Dakota, Vermont, West Virginia, and Wisconsin in the United States.

Discussion. Erlanson (1925) recognized hybridization between *Rosa blanda* and *R. acicularis* subsp. *sayi* in the Mackinac region of Michigan.

Pollen fertility. *Rosa blanda*, $n = 7$, × *Rosa acicularis*, $n = 21$: semi-fertile F1 (Erlanson, 1934).

Paratypes. CANADA. **Ontario:** Sudbury Distr., 4 mi. E of Massy, 19 June 1957, *W. H. Lewis & M. Elvin-Lewis 3507*; Whitefish, 19 June 1957, *W. H. Lewis & M. Elvin-Lewis 3507A* (MO). **Quebec:** Gatineau Co., 1 mi. W of Kazabazua, 22 June 1947, *J. M. Gillett, J. A. Calder & W. J. Cody 1255* (DAO, MO).

U.S.A. **Indiana:** Porter Co., Chesterton, Lake Michigan, 22 Aug. 1915, *C. C. Deam 18002* (IND). **Maine:** Lincoln, Monegan Island, 26 Aug. 1921, *J. R. Churchill s.n.* (MO). **Massachusetts:** Hampton Co., Granville, Cranberry Bog, 22 Sep. 1913, *F. C. Seymour 79* (MO); Berkshire Co., Berkshire, Aug. 1900, *N. F. Flynn s.n.* (VT). **Michigan:** Alger Co., Autrain, 27 July 1940, *A. Chandler 4664* (MICH, MO); Emmet Co., 2 mi. W of Mackinac City, End Bay, 1 Sep. 2004, *W. H. Lewis & E. G. Voss 15892* (MO); Houghton Co., Houghton, 18 July 1892, *A. F. Eby s.n.* (MICH, MO); Mackinac Co., Scottie Bay, 1924, *E. W. Erlanson & C. O. Erlanson U.M.G. No. 7/4* (MICH). **New York:** Warren Co., Lake George, Sabbath-Day Point, 2 July 1947, *H. D. House 30650* (MO, NYS). **Vermont:** Addison Co., Apple Tree Bay, Ferrisburg, 26 June 1981, *P. F. Zika 3776* (VT); Bristol Pond Bog, 25 Sep. 1878, *C. G. Pringle s.n.* (VT); Button Island, Ferrisburg, 24 June 1983, *P. F. Zika 7265* (VT); Rutland Co., West Haven, 15 Sep. 1932, *D. S. Carpenter s.n.* (VT); Chittenden Co., Burlington, 5 July 1942, *L. A. Charette s.n.* (VT); Essex Co., Rutland Co., Castelon, 17 July 1968, *L. A. Charette 3211* (VT). **Wisconsin:** Brown Co., Aug. 1890, *J. H. Schuette s.n.* (NY); Door Co., Little Sturgeon Bay, 1890, *J. H. Schuette s.n.* (GH).

13. Rosa ×victoriana W. H. Lewis, nothosp. nov. [*Rosa nutkana* C. Presl × *Rosa pisocarpa* A. Gray]. TYPE: Canada. British Columbia: Savannas, 30 Aug. 1892, *F. E. Floyd s.n.* (holotype, NY).

MISSOURI
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HERBARIUM
N° 6317869
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0 1 2 3 4 5 6 7 8 9 10
cm
Rosa x peraxeliana W. H. Lewis
. R. blanda Ait. x R. acicularis Lindl.
Det. by Lewis, W. (MO) 2016
Missouri Botanical Garden (MO)
Rosa acicularis Lindl. subsp.
Sayi (Schwein.) W.H. Lewis
x blanda Aiton
Det. by Lewis, W. (MO) 2015
Missouri Botanical Garden (MO)
PLANTS OF ONTARIO, CANADA
Rosaceae
Rosa acicularis Lindl.
?
County: RAINY RIVER Township:
Sable Island Provincial Nature Reserve, southeast Lake of the Woods
NAD: 83 UTM Zone: 15 Easting: 377244 Northing: 5416362
Latitude: 48.88805 Longitude: -94.67459
common on dunes
flowering
Coll.: M.J. Oldham, S. Brinker & W.D. Bakowsky Coll. No.: 35642
Coll. Date: June 29, 2008 Det: M.J. Oldham
DUPES: MO

Figure 11. *Rosa* ×*per-axeliana* W. H. Lewis. Holotype, *M. J. Oldham, S. Brinker & W. D. Bakowsky 35642* (MO).

Haec nothospecies inter parentes *Rosam nutkanam* C. Presl et *R. pisocarpam* A. Gray intermedia, sed a hac caule robustiore, ab illa floribus minoribus atque hypanthiis fructiferis 6–9 mm longis globosis ovoideisve in collum mediocrem desinentibus distinguitur.

Stems stout as in *Rosa nutkana*, typically armed with straight, infrastipular prickles or absent. Leaflets are 5 to 9, oblong to obovate, sharply serrate and lightly pubescent. Sepal margins glabrous, slender. Similar to *R. pisocarpa* in having smaller flowers, 2.5–

3.5 cm, and hips, 6–9 mm, globose to ovoid with modest necks. Pedicels similar to both parental species in being glabrous, glandular.

Etymology. *Rosa* ×*victoriana* is named in honor of Queen Victoria, who established the provincial capital in Victoria, British Columbia, and to honor Victoria City (where I was largely raised).

Vernacular name. Victoria rose.

Distribution. *Rosa* ×*victoriana* is found in British Columbia in Canada. There is shared distribution of both parental taxa in British Columbia in Canada, and in California, Oregon, and Washington in the United States.

Discussion. *Rosa* ×*victoriana* is named as a nothospecies. Two of the three subspecies of *R. nutkana* occur within its range; it is believed that *R. nutkana* subsp. *nutkana* is the probable parent of the specimens seen.

Paratype. CANADA. **British Columbia:** Yale, 10 June 1952, *T. M. C. Taylor & W. H. Lewis 102* (MO, UBC).

Rose Introgressions

Examples of *Rosa* introgressive hybridizations illustrate backcrossing of hybrids that provide intermediary taxa whereby exchange of genetic factors between parents is possible. Such exchanges are illustrated here involving six taxa, *R. acicularis* subsp. *sayi*, *R. arkansana*, *R. blanda*, *R. carolina*, *R. virginiana*, and *R. woodsii* subsp. *woodsii*, and one nothotaxon, *Rosa* ×*mediocciden tis* W. H. Lewis. Collections of each of these six taxa and the nothotaxon were carefully examined for morphological evidence of hybrid introgression in process, together with the identity of taxon and nothotaxa. Each species or nothospecies was further examined to be certain of the identity of both taxa. Distinctive morphology of each introgressant was observed and is provided for each specimen within brackets.

1. introgressions into *Rosa arkansana*

Introgressant *Rosa acicularis* subsp. *sayi*: CANADA. **Alberta:** Banff hwy., 8 July 1958, *J. G. Parker s.n.* (ALTA); Bulwark, 12 July 1929, *E. Moss 1858* (ALTA) [hypanthia oblong with neck]; U of A Kinsella Ranch, hwy. 619, S, 1 July 2010, *B. C. Alexander 63* (ALTA) [hypanthia globose to oblong with neck]; Edmonton, prairie point, 17 July 1984, *J. Meldrum 21* (ALTA) [hypanthia oblong with neck]; Calgary, Banff hwy., 8 July 1958, *J. G. Parker s.n.* (ALTA) [hypanthia ovate with neck]. **Manitoba:** Sandlands Forest Reserve, 14 July 1949, *A. J. Breitung 792* (DAO, MO) [hypanthium oblong with neck].

U.S.A. **Colorado:** Fremont Co., Hillside, 8200 ft., 12 July 1925, *C. O. Erlanson 1471* (MICH, MO) [hypanthia oblong with neck & to 9 leaflets]. **Illinois:** Marshall Co., S of Henry, 23 June 1950, *W. H. Schase 11170* (MISS) [hypanthia oblong, long neck]. **Maine:** Franklin Co., Eustis, near Flagstaff Lake, 20 July 2009, *A. V. Gilman 9081* (MO, VT) [hypanthia oblong with distinct neck]; **Wyoming:** Weston Co., Boyd, 21 July 1910, *A. Nelson 9635* (MO, RM) [hypanthia urceolate].

2. introgressions into *Rosa blanda*

Introgressant *Rosa acicularis* subsp. *sayi*: U.S.A. **Vermont:** Orleans Co., Coventry, E Barton River, 4 July 2009, *A. V. Gilman 09061* (VT) [hypanthia ovate to oblong with neck].

Introgressant *Rosa carolina* subsp. *carolina*: CANADA. **Quebec:** Gateneau Co., Aylwin Parish, 1 mi. W Kazabazua, 22 June 1947, *J. M. Gillett, J. A. Colder & W. J. Cody 1255* (MO, MT) [stems and branches with scattered, thin prickles singly or paired often to apex].

U.S.A. **New York:** Warren Co., Lake George, Sabbath-day Point, 2 July 1947, *H. D. House 30650* (MO, NYSM); Bakers Mills, 2 mi. W, 1 July 1954, *W. H. Lewis 1956* (MO) [stem armature in pairs of short, fine prickles with scattered aciculi].

Introgressant *Rosa woodsii* subsp. *woodsii*: CANADA. **Alberta:** Fort Saskachewan, 2 mi. NE, 1 Aug. 1939; *G. H. Turner 11421* (ALTA) [stems with thin, scattered prickles, devoid toward apex]; Windy Point Ridge, Hwy. 11, W, 14 Aug. 2007, *D. M. Fabijan 2803* (ALTA) [stems with long thin prickles, broad bases, in addition to acicular prickles]; Pinawa, 23 May 1968, *W. N. Chunys 1537* (MMMN) [stems with typical prickles of *R. woodsii* subsp. *woodsii*.].

3. introgressions into *Rosa carolina*

Introgressant *Rosa virginiana*: U.S.A. **New York:** Onondaga Co., Green Lakes State Park, 2 July 1954, *W. H. Lewis 2180* (MO) [both hypanthia with stipitate glands, prickles rare].

4. introgressions into *Rosa* ×*mediocciden tis* [*Rosa arkansana* × *Rosa carolina*]

Introgressant *Rosa acicularis* subsp. *sayi*: U.S.A. **Missouri:** Jackson Co., 0.5 mi. W of Kelly Rd., Kansas City line, 22 May 2005, *W. H. Lewis & M. Elvin-Lewis 15835* (MO) [hypanthia pyriform with neck]; Daviess Co., Gallatin, 6 Aug. 1954, *W. H. Lewis 2394* (MO) [leaflet margins 2-dentate serrate].

5. introgressions into *Rosa virginiana*

Introgressant *Rosa acicularis* subsp. *sayi*: CANADA. **Quebec:** Mont Commis, St.-Donat de Rimouski, 1043, *E. Hepage 6042* (MT) [sepals & hypanthia eglandular, pedicels reflexed, leaflet margins 2-dentate serrate].

U.S.A. **Maine:** Somerset Co., by Skowhegan, Kennebec River at Great Eddy, 13 July 2008, *W. H. Lewis & A. Haines 21137* (MO) [leaflet margins 2-serrate]; Emmet Co., 2 mi. W of Mackinaw City beach, 1 Sep. 2004, *W. H. Lewis & E. G. Voss 15892* (MO) [most hypanthia pyriform, base cuneate]. **Vermont:** Chittenden Co., Burlington, 4 Aug. 1900, *A. V. Gilman s.n.* (VT) [some leaflet margins 2-dentate serrate, hypanthia stipitate glandular]; Addison Co., Varrisburg, Button Island, 26 June 1981, *P. F. Zika s.n.* (VT) [some leaflet margins 2-serrate, hypanthia stipitate glandular].

Introgressant *Rosa blanda*: U.S.A. **Maine:** Somerset Co., by Skowhegan, Kennebec River at Great Eddy, 15 June 2012, *W. H. Lewis 21467* (MO) [lack of all prickles].

6. INTROGRESSIONS INTO *ROSA WOODSII* SUBSP. *WOODSII*

Introgressant *Rosa acicularis* subsp. *sayi*: CANADA. **Alberta:** Jasper Lake, Jasper Natl. Park, 6 July 1976, *D. D. Sharp A382* (ALTA) [hypanthia ovoid with neck]; W Hanna, 10 June 1973, *L. & G. Goulden* (ALTA) [hypanthia urceolate with neck].

U.S.A. **Colorado:** Andre's Shetland Ranch, 8200 ft., 12 July 1896, *C. F. Baker s.n.* (MO) [hypanthia urceolate with neck]; Montezuma Co., Mancos, 22 June 1898, *C. F. Baker, F. S. Earle & S. M. Tracy 43* (MO) [hypanthia urceolate with neck]; Larimore Co., Mtn. Park, Hwy. 14, 6 June 1880, *P. Schmunk 24* (MO) [hypanthia oblong with neck]; Park Co. Insmont, July 1915, *W. E. Ligget s.n.* (MO) [hypanthia ovoid with long neck].

Dual introgressions of *Rosa acicularis* subsp. *sayi* and *R. arkansana*: CANADA. **Alberta:** Atikameg, Little Utikuma Lake, 8 July 1968, *M. G. Dumais & K. Anderson 3234* (ALTA) [leaflet margins 2-dentate serrate; leaflets large, 2–3.3 cm; hypanthia globose, stipitate glandular; sepals stipitate glandular].

U.S.A. **Colorado:** Fremont Co., 3 mi. W of Hillside, 8200 ft., 12 July 1925, *C. O. Erlanson 1471* (MICH, MO) [hypanthia urceolate with neck; leaves with 9 leaflets].

Discussion. As an example of *Rosa* introgression in progress, I found *R. woodsii* subsp. *woodsii*, originally obtained in central Alberta, Canada, planted in a small roadside garden in northern Newfoundland. While there I obtained living material (stems less than 1 ft. tall) and planted one rooted stem in my wild-rose garden in St. Louis Co., Missouri. After four years, the shrub had reached 2 ft. tall, was well naturalized, and was typical of other *R. woodsii* subsp. *woodsii* growing in the garden. In its fourth year, at least eight upper leaves were expressing leaf introgressions typical of *R. arkansana* by having nine to 10 leaflets per leaf, rather than the typical five to seven leaflets of *R. woodsii* subsp. *woodsii*. Given that the plant originated in Alberta, where *R. arkansana* is prominent and uniquely distinguished from other *Rosa* by having, among other major features, nine or often more leaflets per leaf, this individual of *R. woodsii* subsp. *woodsii* is now clearly expressing genes of *R. arkansana*. Such introgression is undoubtedly an indication of hybridization between *R. arkansana* and *R. woodsii* subsp. *woodsii*. *Rosa arkansana* × *R. woodsii* subsp. *woodsii* has been repeatedly observed and is named above as a nothotaxon, *Rosa* ×*oldhamii*.

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New Boraginales from Tropical America 8. Two New Species of *Tournefortia* (Heliotropiaceae) from Costa Rica

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ABSTRACT. *Tournefortia albifolia* J. S. Mill. and *T. longipedicellata* J. S. Mill. are described as new from Costa Rica, bringing the total number of *Tournefortia* L. species known from Costa Rica to 16. They are described, their affinities are discussed, information is provided to allow them to be separated from the other species with which they may be confused, and their conservation status is determined.

Key words: Costa Rica, Heliotropiaceae, IUCN Red List, *Tournefortia*.

Costa Rica has continued to yield new species of Boraginales, particularly in the genera *Bourreria* P. Browne, *Cordia* L., and *Tournefortia* L. (Miller, 1987, 1988, 1999; Miller & Sirot, 1997; Gottschling & Miller, 2005). In preparing a treatment for the *Manual de Plantas de Costa Rica* (Hammel et al., 2015), a series of collections of *Tournefortia* species were encountered in the Costa Rican herbaria CR and INB that were not immediately assignable to species known from that country. Additional study and comparison with other species from Latin America led to the conclusion that these specimens represent two previously unrecognized species; these are described below, bringing the total number of *Tournefortia* species known from Costa Rica to 16.

1. Tournefortia albifolia J. S. Mill., sp. nov. TYPE: Costa Rica. Heredia: Estacion Biologica La Selva cerca de Puerto Viejo de Sarapiqui, 100 m, 10°26′N 84°01′W, *B. Hammel & I. Quintanilla 17330* (holotype, CR; isotypes, DUKE, MO). Figure 1.

Diagnosis. The new species is similar in general appearance to *Tournefortia hirsutissima* L., but is distinguished by its narrower leaves with a conspicuously white abaxial surface and a papillate upper surface and its smaller flowers with lanceolate sepals less than 1.5 mm long and corolla less than 5 mm long.

Liana, stems hirsute to strigose. Leaves alternate, leaf blades elliptic to narrowly elliptic or lance-elliptic, 8–15(–18) × 2.5–5(–6.5) cm, apex narrowly acute to acuminate, base cuneate, margins entire, adaxial surface sparsely scabrid and slightly rough to the touch, surface distinctly and evidently papillate, abaxial surface white, sparsely hirsute with surface covered with a white granular wax, venation brochidodromous, secondary veins 8 to 9, tertiary veins reticulate and evident; petioles 1–2.5(–3) cm, broadly canaliculated on adaxial surface, evenly to sparsely hirtellous. Inflorescences terminal, cymose, to ca. 15 cm broad, peduncle sparsely hirsute. Flowers bisexual, borne 1–3 mm apart on the inflorescence branches, sessile; calyx small, lobes lanceolate, 1–1.5 mm, sparsely hirtellous; corolla tubular, 4–5 mm; corolla tube white scabrid on outer surface; anthers inserted in corolla mouth; ovary ovoid, stigma sessile. Fruits ovoid, 3 cm in diam., stigma sometimes persistent on top of fruits.

Distribution and habitat. *Tournefortia albifolia* is known from only three localities: two in the Atlantic lowlands of Caribbean Costa Rica in wet lowland forest and a single collection from a mid-elevation site in Chiapas.

IUCN Red List category. Known from only three localities, *Tournefortia albifolia* must be considered Data Deficient (DD), according to IUCN Red List criteria (IUCN, 2012). It is certainly a rare plant and probably qualifies as Endangered (EN) because of its very low area of occupancy. However, the three known populations are scattered geographically and it is presumed to be rare at all three sites. The population at the La Selva Biological Station is well protected.

Discussion. *Tournefortia albifolia* is quite similar in general appearance to one of the most common Central American species, *T. hirsutissima* L., but it is easily distinguished by its prominent white leaf undersurface. It also differs in the distinctive papillate upper surface of its leaves, its leaves that are narrower than those of *T. hirsutissima*, its flowers that are smaller in comparison and have lanceolate sepals less than 1.5 mm long, and its corolla that is less than 5 mm long. It does occur sympatrically with *T. hirsutissima* at La Selva.

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Figure 1. *Tournefortia albifolia* J. S. Mill. —A. Flowering branch. —B. Flowers. —C. Fruit. All from *B. Hammel & I. Quintanilla 17330* (MO).

Paratypes. COSTA RICA. **Heredia:** Cantón Sarapiqui, OET La Selva, puente de la quebrada Surá, camino a la Estacion del Río, *O. Vargas 1265* (LSCR); Canton Sarapiqui, OET La Selva, Sendero STR, 410 m, izquierda 1 m x quebrada, *O. Vargas 2023* (LSCR). **Limón:** dan la foret a Shirores, Talamanca, 100 m, *A. Tonduz 9321* (CR). MEXICO. **Chiapas:** 13 km N of Berriozabal near Pozo Turipache and Finca El Suspiro, Mpio. Berriozabal, 1000 m, *Breedlove 39897* (MO).

2. Tournefortia longipedicellata J. S. Mill., sp. nov. TYPE: Costa Rica. Limón: Rio Banano, Cuenca del Banano. Limón, Valle de la Estrella, Fila Matarna, cerca de 11 km SW del pueblo de Aguas Zarcas, elev. 1200–1300 m, 9°48′49″N, 83°10′02″W, 25 Oct. 2007, *D. Solano, A. Rodríguez, B. Gamboa R., D. Santamaría, E. Boza & M. Hernández Peña 4705* (holotype, CR; isotypes, MO, PMA). Figure 2.

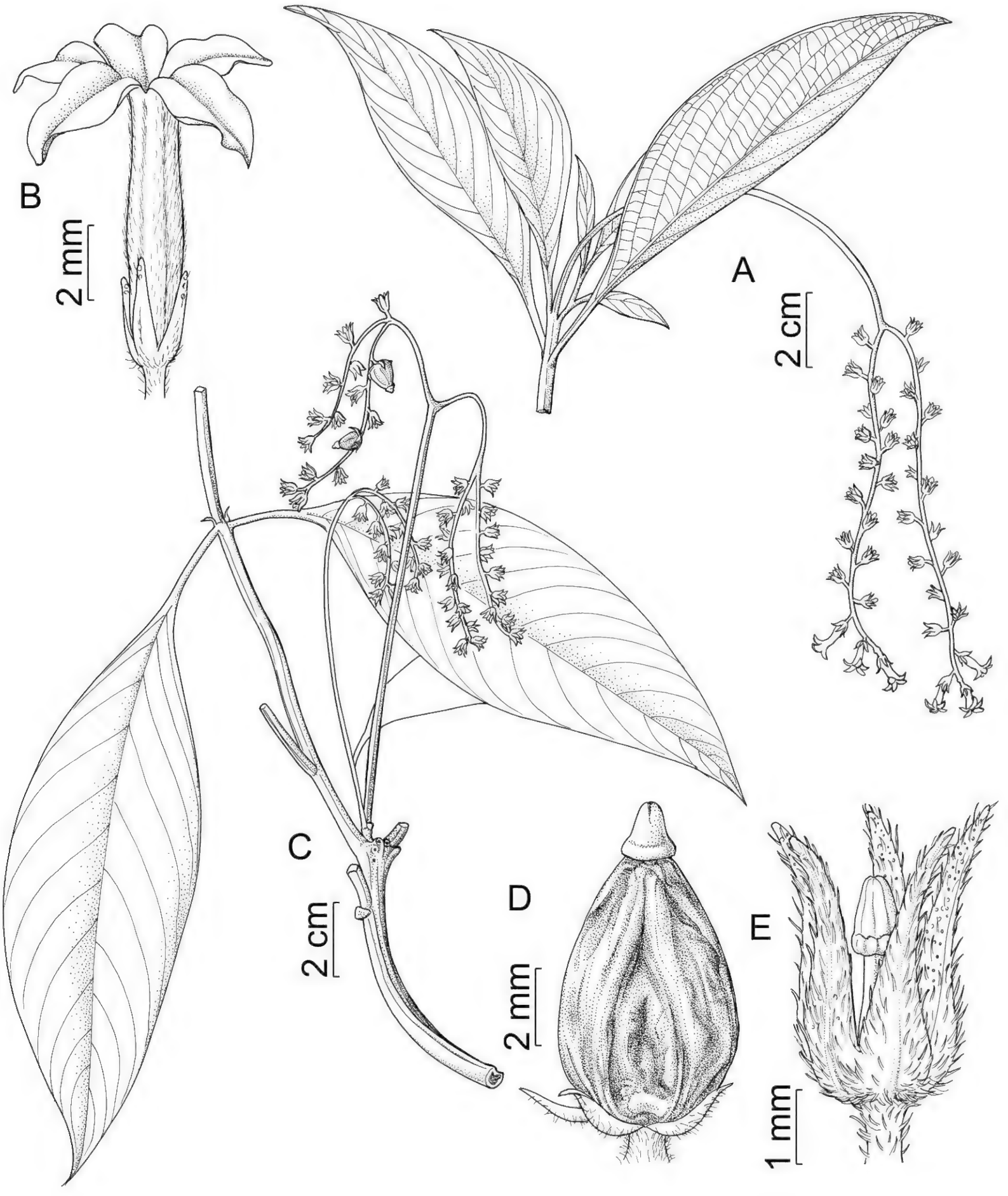

Figure 2. *Tournefortia longipedicellata* J. S. Mill. —A. Flowering branch. —B. Flower. —C. Fruiting branch. —D. Fruit. —E. Gynoecium in persistent calyx. All from *J. Bittner 1828* (MO).

Diagnosis. The new species is similar to *Tournefortia johnstonii* Standl. and *T. ramonensis* Standl. by its opposite leaves, but differs from both of these species by its distinctly pedicellate flowers.

Shrub to 4 m tall, stems evenly short brown puberulent. Leaves opposite; blades elliptic to ovate, 15–25 × 5–10.5 cm, apex acuminate, base obtuse to acute or rounded, margin entire, adaxial surface soft scabrid, abaxial surface soft brown puberulent, venation brochidodromous, secondary veins 8 to 12; petioles 2–3(–7) cm, canaliculated on adaxial surface, evenly short brown puberulent. Inflorescences terminal and subtended by a pair of lateral branches from subtending axillary buds, cymose, on peduncles 3.5–11 cm, branches 8–25 cm, soft brown puberulent to nearly glabrous. Flowers bisexual,

borne 2–4 mm apart, on distinct pedicels 1–5 mm; sepals lanceolate, 1.5–2(–4) mm, spreading, corolla tubular with recurved lobes, tube 3–4 mm, exterior surface white strigose, lobes narrowly acute, acuminate, recurved; anthers sessile in mouth of corolla; ovary ovoid, 1–1.5 mm, style 1.5–2.5 mm, stigma conical. Immature fruits ovoid, mature fruits unknown.

Distribution and habitat. *Tournefortia longipedicellata* is endemic to Costa Rica, but it is distributed throughout the central mountains from ca. 1000 to 2400 m.

IUCN Red List category. Although endemic to Costa Rica, *Tournefortia longipedicellata* appears to be reasonably abundant in the central mountains and exceeds extent of occurrence and area of occupancy threat thresholds and should be considered Least Concern (LC), according to IUCN Red List criteria (IUCN, 2012).

Discussion. *Tournefortia longipedicellata* is a very distinctive species that has previously been confused with *T. johnstonii* Standl. and *T. ramonensis* Standl., which are all unusual among the Central American members of the genus in having opposite leaves. It differs from both of those species in having flowers borne on distinct pedicels at least 1 mm long. All three species appear to be reasonably abundant, and perhaps even a bit weedy, in mid-elevation wet forests in central Costa Rica.

Paratypes. COSTA RICA. **Alajuela:** Universidad de Costa Rica Forest Preserve, Cordillera de Tilaran, Atlantic slope cloud forest, along the Río San Lorenzo below the Fila Volcan Muerte, 1000–1500 m, 10°12′N, 84°37′S, *Berringer et al. 2467* (MO); Parque Nacional Rincón de la Vieja Quebrada Rancho Grande, 1000 m, 10°47′00″N, 85°17′00″W, *Rivera 1593* (MO); San Ramón, entre La Balsa y Rio Cataratitas, 1160 m, *G. Umana et al. 650* (CR). **Cartago:** Turrialba, Tayutie, area no protegida, Moravia, Grano de Oro, Cumbre de Cerro Tigre, Cuenca superior del Lago Ayil, 1600 m, *G. Herrera & G. Vargas 8872* (CR). **Limón:** Cantón de Talamanca Quebrada Kuisa, near the camp, Cordillera de Talamanca, *J. Bittner 1828* (INB, MO); Río Banano, Cuenca del Banano, Limón, Valle de la Estrella, Fila Matama, cerca de 11 km SW del pueblo de Aguas Zarcas, 1200–1300 m, *D. Santamaría 6544* (INB, MO, PMA). **San Jose:** San Gerardo de Dota, Reserva Forestal Los Santos, Cordillera de Talamanca, 2000–2400 m, *L. van Omme & G. M. ten Hoopen 394* (CR); San Gerardo de Dota, Talamanca, 2300 m, *H. van Velzen & M. Kappelle 942* (CR).

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Nomenclatural Changes in Neotropical Riverweeds (Podostemaceae)

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Abstract. Twenty-four nomenclatural changes are made in Neotropical Podostemaceae. Twenty-one species or infraspecific names are placed into synonymy, three new taxonomic combinations are presented, and five species are recognized as dubious. Four lectotypes are designated. Species involved occur in *Apinagia* Tul., *Castelnavia* Tul. & Wedd., *Jenmaniella* Engl., *Marathrum* Bonpl., *Oserya* Tul. & Wedd., *Rhyncholacis* Tul., and *Wettsteiniola* Suess. Clarifications of the location of types of one species each of *Castelnavia* (*C. monandra* Tul. & Wedd.) and *Ceratolacis* Wedd. (*C. erythrolichen* (Tul. & Wedd.) Wedd.) are also presented.

Resumo. São realizadas vinte e quatro mudanças nomenclaturais em Podostemaceae neotropicais. Vinte e um nomes de espécies ou infraespecíficos são sinonimizados, três novas combinações são apresentadas e cinco espécies são reconhecidas como dúbias. Cinco lectótipos são designados. As espécies envolvidas ocorrem em *Apinagia* Tul., *Castelnavia* Tul. & Wedd., *Jenmaniella* Engl., *Marathrum* Bonpl., *Oserya* Tul. & Wedd., *Rhyncholacis* Tul. e *Wettsteiniola* Suess. Esclarecimentos em relação à localização dos tipos de uma espécie de *Castelnavia* (*C. monandra* Tul. & Wedd.) e de *Ceratolacis* Wedd. (*C. erythrolichen* (Tul. & Wedd.) Wedd.) são apresentados.

Key words: *Apinagia*, *Castelnavia*, *Ceratolacis*, *Jenmaniella*, *Marathrum*, *Oserya*, Podostemaceae, *Rhyncholacis*, South America, *Wettsteiniola*.

Philbrick et al. (2010) reported that nearly 30% of Neotropical species of Podostemaceae are of unclear taxonomic status. Taxonomic uncertainty hinders the ability to accurately assess the extent of local species endemism and thereby clarify conservation concerns (Philbrick et al., 2010). Herein we make nomenclatural changes based on examination of type materials and place species into synonymy with others, transfer species from one genus to another, and denote dubious species. The proposed changes enhance taxonomic clarity in Neotropical Podostemaceae.

Materials and Methods

This study was based on type materials deposited in the following herbaria (Thiers, continuously updated): B, BM, BR, C, CGE, ESA, F, G, GH, GOET, K, L, LE, NY, P, S, U, US, and W.

Species Placed into Synonymy

The following changes move previously recognized species into synonymy of others. In each instance, examination of type materials indicated that the range of variation in vegetative and reproductive features of synonymized taxa falls within the observed range for the accepted taxa.

Apinagia fimbrifolia P. Royen, Meded. Bot. Mus. Herb. Rijks Univ. Utrecht 107: 62–63, 130, tab. 8, figs. 13–17. 1951. TYPE: Brazil. Distrito Federal, Paranoá River, "Rio Paranáua, Goyaz, Brésil," 28 May 1895, *A. Glaziou 21982* (holotype, P; isotypes, C [exsiccatae], [spirit], F, G, K, S not seen).

"*Apinagia crulsiana* Warm. ex Glaz.," Bull. Soc. Bot. France 58 (Mém. 3f): 574. 1911, nom. nud.

"*Apinagia intermedia* Warm. ex Glaz.," Bull. Soc. Bot. France 58 (Mém. 3f): 574. 1911, nom. nud.

Apinagia parvifolia P. Royen, Meded. Bot. Mus. Herb. Rijks Univ. Utrecht 107: 64–65, 130, tab. 7, figs. 17–24. 1951, syn. nov. TYPE: Brazil. Distrito Federal, Gama River, "Bas du rio Gama, Goyaz, Brésil," 4

Nov. 1894, *A. Glaziou 21992* (holotype, U [photo]; isotypes, C not seen, F, K, P).

Apinagia latifolia (K. I. Goebel) P. Royen, Meded. Bot. Mus. Herb. Rijks Univ. Utrecht 107: 59. 1951. *Oenone latifolia* K. I. Goebel, Pflanzenbiol. Schilderungen 2: 375–376, tab. 26, figs. 1, 2. 1893. TYPE: Guyana. Barima River, "Cataract of Barima, Guiana," 26 Apr. 1893, *K. I. Goebel s.n.* (holotype, M; isotypes, C not seen, K, U).

Apinagia imthurnii (K. I. Goebel) P. Royen, Meded. Bot. Mus. Herb. Rijks Univ. Utrecht 107: 58–59. 1951, syn. nov. *Oenone imthurnii* K. I. Goebel, Pflanzenbiol. Schilderungen 2: 347, 376–377. 1893. TYPE: Guyana. Amakura River, "Cataract of Amacura, Brit. Guiana," 26 Apr. 1893, *K. I. Goebel s.n.* (holotype, M; isotypes, B [spirit], C [exsiccatae], [spirit], K, U).

Apinagia richardiana (Tul.) P. Royen, Meded. Bot. Mus. Herb. Rijks Univ. Utrecht 107: 44–45. 1951. *Ligea richardiana* Tul., Ann. Sci. Nat., Bot., sér. 3, 11: 96. 1849. *Neolacis richardiana* (Tul.) Wedd., Prodr. [A. P. de Candolle] 17: 59–60. 1873. *Oenone richardiana* (Tul.) Warm., Nat. Pflanzenfam. [Engler & Prantl] 3, Abt. 2a: 18. 1891. TYPE: French Guiana. s. loc., s.d., *L. Richard s.n.* (lectotype, designated here, P; isotypes, B [spirit], BM [spirit]).

Apinagia corymbosa (Tul.) Engl. var. *capillarifolia* (Engl.) P. Royen, Meded. Bot. Mus. Herb. Rijks Univ. Utrecht 107: 53, tab. 3, figs. 5–7. 1951, syn. nov. *Apinagia capillarifolia* Engl., Bot. Jahrb. Syst. 61(2–3, Beibl. 138): 3. 1927. TYPE: Brazil. Roraima: Serra do Mel, Surumu River, tributary of Branco River, "in einem Bache bei der Serra do Mel; Rio Branco (Surumu)," Oct. 1909, *E. Ule 30* (holotype, B).

Apinagia corymbosa (Tul.) Engl. var. *corymbosa*, Nat. Pflanzenfam., ed. 2 [Engler & Prantl] 18a: 38. 1930, syn. nov. *Ligea richardiana* Tul. var. *corymbosa* Tul., Ann. Sci. Nat., Bot., sér. 3, 11: 96–97. 1849. *Neolacis corymbosa* (Tul.) Wedd., Prodr. [A. P. de Candolle] 17: 60. 1873. TYPE: Guyana. "Guyane angl.," 1837, *R. Schomburgk 436* (holotype, P; isotypes, C [exsiccatae not seen], [spirit not seen], K, L not seen, U, US, W not seen).

Apinagia exilis (Tul.) P. Royen, Meded. Bot. Mus. Herb. Rijks Univ. Utrecht 107: 53–54, tab. 3, figs. 8–13. 1951, syn. nov. *Ligea richardiana* Tul. var. *exilis* Tul., Ann. Sci. Nat., Bot., sér. 3, 11: 96–97. 1849. *Neolacis corymbosa* (Tul.) Wedd. var. *exilis* (Tul.) Wedd., Prodr. [A. P. de Candolle] 17: 60. 1873. TYPE: Guyana. s. loc., s.d., *R. Schomburgk 434* (holotype, P; isotypes, BM, C, CGE not seen, K [2 sheets], L not seen, US, W not seen).

Apinagia microcarpa Engl., Bot. Jahrb. Syst. 61(2–3, Beibl. 138): 3. 1927. TYPE: Brazil. Roraima: Branco River, "In den Stromschnellen des unteren Surumu; Rio Branco," Jan. 1909, *E. Ule 7964* (holotype, B).

Apinagia minor P. Royen, Meded. Bot. Mus. Herb. Rijks Univ. Utrecht 107: 52, 129, tab. 6, figs. 1–10. 1951. TYPE: Brazil. Pará: Erepecuru River, Oriximiná "Aripecuru," Dec. 1849, *R. Spruce 555* (holotype, P; isotype, K).

Apinagia secundiflora (Tul.) Pulle, Enum. Vasc. Pl. Surinam, 194. 1906, syn. nov. *Ligea secundiflora* Tul., Ann. Sci. Nat., Bot., sér. 3, 11: 97. 1849. *Neolacis secundiflora* (Tul.) Wedd., Prodr. [A. P. de Candolle] 17: 62. 1873. *Oenone secundiflora* (Tul.) Engl., Bot. Jahrb. Syst. 61(Beibl. 138): 2. 1927. *Apinagia secundiflora* (Tul.) Engl., Nat. Pflanzenfam., ed. 2 [Engler & Prantl] 18a: 38. 1930, isonym. TYPE: Suriname. "Guiana batava," s.d., *F. Hostmann 1323* (holotype, K; isotypes, BM, P, W not seen).

Apinagia uleana Engl., Bot. Jahrb. Syst. 61(Beibl. 138): 3. 1927. TYPE: Brazil. Rio Branco, Feb. 1909, *E. Ule s.n.* (type not found).

"*Lacis chrysanthemum* Schnizl.," Iconogr. Fam. Regn. Veg. 2: tab. 85. [1843–1870], nom. nud.

Oenone othmeri Matthiesen, Biblioth. Bot. 15 (Heft 68): 13, 48. 1908. TYPE: Venezuela. Caroni River, "in fluvi Caroni," 22 Feb. 1902, *B. Othmer s.n.* (holotype, B [exsiccatae]; isotypes, B [spirit], C not seen).

Apinagia riedelii (Bong.) Tul., Ann. Sci. Nat., Bot., sér. 3, 11: 98. 1849. *Lacis riedelii* Bong., Mém. Acad. Imp. Sci. Saint-Pétersbourg, Sér. 6, Sci. Math., Seconde Pt. Sci. Nat. 3(2): 75, tab. 3. 1835. *Neolacis riedelii* (Bong.) Wedd., Prodr. [A. P. de Candolle] 17: 61–62. 1873. TYPE: Brazil. São Paulo: Avanhandava River, Tietê tributary, "Brasilia Guyandába," s.d., *L. Riedel 392* (holotype, LE not seen; isotypes, B, BM, C not seen, G, P).

Apinagia fucoides (Mart. & Zucc.) Tul., Ann. Sci. Nat., Bot., sér. 3, 11: 98. 1849, syn. nov. *Lacis fucoides* Mart. & Zucc., Nov. Gen. Sp. Pl. (Martius) 1(1): 5–6, tab. 2. 1824. *Neolacis fucoides* (Mart. & Zucc.) Wedd., Prodr. [A. P. de Candolle] 17: 61. 1873. TYPE: Brazil. Bahia: Ilhéus, Itaipe River, "Brasilia, in rivulis ad fluvi Itahype," Dec. s.a., *C. Martius 2056* (holotype, M; isotypes, B, L not seen, P, W not seen).

Apinagia psyllophora Tul. & Wedd., Ann. Sci. Nat., Bot., sér. 3, 11: 97. 1849, syn. nov. *Neolacis psyllophora* (Tul. & Wedd.) Wedd., Prodr. [A. P. de Candolle] 17: 60. 1873. TYPE: Brazil. Tocantins River, s.d., *H. A. Weddell 2368* (holotype, P; isotypes, C, F not seen, K, P [2 sheets]).

Apinagia pygmaea (Bong.) Tul., Ann. Sci. Nat., Bot., sér. 3, 11: 99, tab. 4, figs. 1–8. 1849, syn. nov. *Lacis pygmaea* Bong., Mém. Acad. Imp. Sci. Saint-Pétersbourg, sér. 6, Sci. Math., Seconde Pt. Sci. Nat. 3(2): 77, tab. 3. 1835. *Neolacis pygmaea* (Bong.) Wedd., Prodr. [A. P. de Candolle] 17: 60–61. 1873. TYPE: Brazil. São Paulo: Avanhandava River, Tietê tributary, s.d., *L. Riedel 393* (holotype, LE not seen; isotypes, B, BM, G not seen, K, NY, P, S not seen, U).

Apinagia rangiferina P. Royen, Meded. Bot. Mus. Herb. Rijks Univ. Utrecht 107: 61, 130, tab. 5, figs. 1–6. 1951, syn. nov. TYPE: Brazil. Minas Gerais: Paraíba River, "(Minas) rio Parahyba, au passage," 15 Aug. 1894, *A. Glaziou 22001* (holotype, C not seen; isotypes, P, U [spirit]).

Apinagia yguazuensis Chodat & Vischer in Chodat, Veg. Parag., 241–242. 1917, syn. nov. TYPE: Paraguay.

Yguazu, "Yguazu in ripibus immerses," Oct. 1914, *R. Chodat 341* (holotype, G).

Notes. Based on the synonymy of *Apinagia riedelii* the oldest legitimate basionym for the species is *Lacis fucoides*, published in 1824. Accordingly, the correct name should be *A. fucoides* (Mart. & Zucc.) Tul. Changing the name, however, could lead to confusion as *A. riedelii* has been widely used. A proposal to conserve the name *A. riedelii* is being developed.

Castelnavia monandra Tul. & Wedd., Ann. Sci. Nat., Bot., sér. 3, 11: 109. 1849. TYPE: Brazil. Goiás: Araguaia River, "Brésil, Goyaz, Cataractes de l'Araguay," 1844, *H. A. Weddell s.n.* (holotype, P).

Oserya flabellifera Tul. & Wedd., Ann. Sci. Nat., Bot., sér. 3, 11: 106. 1849, syn. nov. TYPE: Brazil. Goiás: Araguaia River, "Brésil, Prov. de Goyaz, Cataractes de l'Araguay," 1844, *H. A. Weddell s.n.* (holotype, P; isotype, C not seen).

Jenmaniella ceratophylla Engl. var. **ceratophylla**, Bot. Jahrb. Syst. 61(2–3, Beibl. 138): 7–8, figs. A–F. 1927. TYPE: Guyana. Potaro River, "Brit Guiana: Potaro River," Sep. 1898, *G. Jenman 7496* (holotype, B; isotypes, BM, K).

Jenmaniella ceratophylla Engl. var. *hexandra* Engl., Bot. Jahrb. Syst. 61(2–3, Beibl. 138): 8. 1927, syn. nov. TYPE: Guyana. Potaro River, Oct. 1898, *G. Jenman 7497* (holotype, B).

Jenmaniella ceratophylla Engl. var. *parva* P. Royen, Meded. Bot. Mus. Herb. Rijks Univ. Utrecht 107: 125, 137, tab. 16, figs. 14–15. 1951, syn. nov. TYPE: Venezuela. Caroni River, "Venezuela, fl. Caroni," s.d., *B. Othmer s.n.* (holotype, B; isotype, C [exsiccatae], [spirit]).

Jenmaniella varians Engl., Bot. Jahrb. Syst. 61(2–3, Beibl. 138): 7, pl. 8, figs. L–Q. 1927. TYPE: Guyana. Temple Bar Falls, Conawarook River, Sep. 1905, *H. Bartlett 8249* (holotype, B; isotype, K).

Jenmaniella guianensis Engl., Bot. Jahrb. Syst. 61(2–3, Beibl. 138): 8, pl. 8, figs. G–K. 1927, syn. nov. TYPE: Guyana. Amatuk Falls, Potaro River, Oct. 1898, *G. Jenman 7416* (holotype, B; isotypes, BM, K).

Jenmaniella tridactylitifolia Engl., Bot. Jahrb. Syst. 61(2–3, Beibl. 138): 8, pl. 8, figs. R–W. 1927. TYPE: Guyana. Maramba Falls, Mazaruni River, Jan. 1897, *G. Jenman 7189* (holotype, B; isotype, K).

Jenmaniella jenmanii (Engl.) P. Royen, Meded. Bot. Mus. Herb. Rijks Univ. Utrecht 107: 121–122, tab. 14, figs. 4–6. 1951, syn. nov. *Marathrum jenmanii* Engl., Bot. Jahrb. Syst. 61(2–3, Beibl. 138): 5–6. 1927. TYPE: Guyana. Cobanatuk, Potaro River, Oct. 1898, *G. Jenman 7418* (holotype, B; isotype, K).

Marathrum pauciflorum Tul. var. *heterophyllum* P. Royen, Meded. Bot. Mus. Herb. Rijks Univ. Utrecht 107: 89, 133, tab. 16, fig. 20. 1951, syn. nov. TYPE: Guyana. Cuyuni River, 25 Nov. 1929, *N. Y. Sandwith 694* (holotype, K; isotype, BM not seen).

Marathrum aeruginosum P. Royen, Meded. Bot. Mus. Herb. Rijks Univ. Utrecht 107: 84–85, 132, tab. 8, figs. 1–2. 1951. TYPE: Venezuela. Territorio Federal Amazonas: Orinoco River, at Raudal Santa Barbara, betw. Tamatama & San Fernando de Atabapo, 100 m, 7 Sep. 1944, *J. A. Steyermark 58428* (holotype, F).

Apinagia penicillata P. Royen, Meded. Bot. Mus. Herb. Rijks Univ. Utrecht 107: 66–67, tab. 4, figs. 11–16. 1951, syn. nov. TYPE: Suriname. Saramacca River, 11 Oct. 1944, *B. Maguire 24927* (holotype, NY; isotypes, BR, F, GH, K, P, U not seen, US).

Marathrum tenue Liebm., Förh. Skand. Naturf. Möte 5: 511–512. 1849. TYPE: Mexico. Veracruz: Huitamalco, "pro. Huitamalço," May 1841, *F. Liebmann s.n.* (holotype, C).

Apinagia boliviana P. Royen, Meded. Bot. Mus. Herb. Rijks Univ. Utrecht 107: 63–64, 130, tab. 7, figs. 1–16. 1951, syn. nov. TYPE: Bolivia. Apolo, 4800 ft., 6 Sep. 1902, *R. S. Williams 1570* (holotype, NY; isotype, L).

Apinagia peruviana (Wedd.) Engl., Nat. Pflanzenfam., ed. 2 [Engler & Prantl] 18a: 38. 1930, syn. nov. *Neolacis peruviana* Wedd., Prodr. [A. P. de Candolle] 17: 64. 1873. TYPE: Peru. Rio de San Gabán, "Rio de St. Gavan ad lapid inundati," July 1854, *W. Lechler 2298* (lectotype, designated here, W [barcode] W 1889-0264806; isotypes, F, G, GOET [photo], K, L, P, W).

Marathrum kerberi Engl., Bot. Jahrb. Syst. 61(2–3, Beibl. 138): 5. 1927. TYPE: Mexico. La Luz, "La Luz pr. Córdoba ad lapidis in rivulis," 4 Oct. 1882, *E. Kerber 83* (holotype, B; isotypes, BM, BR, C not seen, G, GOET not seen, K not seen, M, P, US not seen).

Neolacis myriophylla Wedd., Prodr. [A. P. de Candolle] 17: 63–64. 1873. *Blandowia myriophylla* (Wedd.) Nash, N. Amer. Fl. 22: 5. 1905. TYPE: Costa Rica. "Rio Virillo," s.d., *C. Hoffmann 271* (holotype, B not seen; isotype, C not seen).

New Combinations

The following new combinations are warranted. A brief explanation is provided for each.

Jenmaniella divertens (Went ex Pulle) C. T. Philbrick & C. P. Bove, comb. nov. Basionym: *Apinagia divertens* Went ex Pulle, Recueil Trav. Bot. Néerl. 6: 267. 1909, nomen; et in Verh. Kon. Akad. Wetensch., Afd. Natuurk., Sect. 2, 16: 35. 1910, descr. TYPE: Suriname. Tapanahony River, "Guyane hollandaise, Tapanah-

ony," 9 Oct. 1904, *G. M. Versteeg 908* (holotype, U; isotypes, K, L not seen, P).

Type materials (*Veersteeg 908*) are fragmentary. Stems are prostrate with pinnately compound leaves; both features occur in species of *Jenmaniella* and *Oserya* Tul. & Wedd. s. str. (cf. Tippery et al., 2011). Mature flowers and capsules are lacking. Figures that accompany the protologue (Went, 1910), however, show a short gynophore and the ovary positioned at a prominent angle relative to the axis of the stamen filaments, which are both features of *Jenmaniella*.

Oserya pilgeri (Mildbr.) C. T. Philbrick & C. P. Bove, comb. nov. Basionym: *Apinagia pilgeri* Mildbr., Beitr. Kenntn. Podostemon., 41. 1904. TYPE: Brazil. Mato Grosso: Formoso River, "Matto Grosso: auf Sandsteinblöcken im Rio Formoso," 16 May 1899, *R. K. Pilger 834* (holotype, B; isotype, L).

Tippery et al. (2011) reported that *Apinagia* Tul. is not monophyletic and recognized *Apinagia* s. str. as a genus composed only of species with upright stems. Prostrate-stemmed species of *Apinagia* occurred in disparate locations among Neotropical Podostemaceae. Tippery et al. also reported that *Oserya*, as recognized by Royen (1954), is not monophyletic. Species in Central America and Mexico previously recognized as *Oserya* were transferred to a new genus (*Noveloa* C. T. Philbrick; Tippery et al., 2011). In contrast, species from South America were retained in *Oserya* s. str.

The type of *Apinagia pilgeri* (*Pilger 834*) is comprised of fragments of prostrate stems, leaf fragments, and numerous dehisced capsules. Examination of reproductive structures indicates that these specimens represent *Oserya* s. str., not *Apinagia* s. str. Material of *Pilger 834* shows one capsule valve to be caducous, which is a feature of *Oserya* s. str., not *Apinagia* s. str. In addition, the number of non-suture ribs per capsule valve of material of *Pilger 834* is six or seven, again indicative of *Oserya* s. str. In contrast, species of *Apinagia* s. str. have three non-suture ribs per valve. The limited material available indicates that stamen number per flower in the *Pilger 834* material is one or two. Although most species of *Oserya* s. str. have one stamen per flower, stamen number for the most widespread species in the genus (*O. perpusilla* (Went) P. Royen) can also be two (Philbrick, unpublished data). The combination of features provides support for *A. pilgeri* being transferred to *Oserya* s. str.

Rhyncholacis squamosa (Wedd.) C. T. Philbrick & C. P. Bove, comb. nov. Basionym: *Marathrum squamosum* Wedd., Prodr. [A. P. de Candolle] 17: 54. 1873. TYPE: Venezuela. San Carlos, Negro River, "prope San carlos ad Rio Negro, Brasiliae borealis," Oct. 1853, *R. Spruce 3102* (lectotype, designated here, P [barcode] P167817; isotypes, B, BM, BR, C not seen, G, K, NY, P, S, W not seen).

Marathrum squamosum Wedd. var. *phellandrifolium* (Engl.) P. Royen, Meded. Bot. Mus. Herb. Rijks Univ. Utrecht 107: 90. 1951, syn. nov. *Oenone phellandrifolium* Engl., Bot. Jahrb. Syst. 61(2–3, Beibl. 138): 2–3. 1927. TYPE: Brazil. Amazonas: São Gabriel da Cachoeira, Caiari River, Matapi waterfall, "Carurú; Matapý-Bach und andere Cachoeiras des Rio Caiarý," 1904, *T. Koch-Grünberg 140* (holotype, B).

Marathrum squamosum Wedd. var. *spruceanum* Wedd., Prodr. [A. P. de Candolle] 17: 54. 1873. TYPE: Brazil. Amazonas: Uaupés River, near Panuré waterfall, "Prope Panure ad rio Uaupés," Oct. 1852–Jan. 1853, *R. Spruce 2579* (lectotype, designated here, K [barcode] K 642024; isotypes, BM, BR, CGE not seen, F, GH not seen, K, NY, P, S, W not seen).

The type materials for *Marathrum squamosum* var. *squamosum* (*Spruce 3102*), *M. squamosum* var. *phellandrifolium* (*Koch-Grünberg 140*), and *M. squamosum* var. *spruceanum* (*Spruce 2579*) all include capsules with two winglike medial ribs that are continuous with the base of the stigmas; these features are distinctive of *Rhyncholacis* Tul. The types of the two latter varieties are not distinguishable from *M. squamosum* var. *squamosum*.

Dubious Species

For each of the species listed below, the type materials were incomplete, i.e., lacking sufficient vegetative and/or reproductive materials to allow recognition of distinct species. A brief explanation is provided for each.

Apinagia goejei Went ex Pulle, Recueil Trav. Bot. Néerl. 6: 266. 1909, nomen; et in Verh. Kon. Akad. Wetensch., Afd. Natuurk., Sect. 2, 16: 39. 1910, descr. TYPE: Suriname. Tapanahony River, "Guyane hollandaise, chutes au confluent des Tapanahony," July 1907, *De Goeje s.n.* (holotype, U [spirit]; isotypes, B [spirit], K, P).

Type materials (*De Goeje s.n.*) comprise small plants with prostrate stems and pinnately lobed leaves; both characters occur in species of *Jenmaniella* Engl., *Oserya* s. str., and *Marathrum* Bonpl. Mature flowers and capsules are lacking; consequently, it is not possible to place the specimen in a specific genus. Type materials are plants that are attached to the bark of a woody shrub, which is not a character that is unique to any given taxon. For

example, we have seen species of *Apinagia*, *Castelnavia* Tul. & Wedd., *Monostylis* Tul., and *Rhyncholacis* occasionally growing attached to rheophytic shrubs.

Oenone hulkiana Went, Verh. Kon. Akad. Wetensch., Afd. Natuurk., Sect. 2. 17(2): 10. 1912. *Apinagia hulkiana* (Went) P. Royen, Meded. Bot. Mus. Herb. Rijks Univ. Utrecht 107: 43–44. 1951. TYPE: Suriname. Awaladam, Gran Rio, 9 Aug. 1910, *J. F. Hulk s.n.* (holotype, L not seen; isotypes, B, BM [spirit]).

Type materials (*Hulk s.n.*) comprise short (2–3 cm) stems with mature simple leaves. A single anthesal flower with a complete whorl of stamens occurs on most stems. Capsules are lacking. Such short stems with one (or few) flowers are common along the margins (shallow water) of populations that otherwise have much longer stems (e.g., 0.1–1 m) and numerous flowers (e.g., *Apinagia flexuosa* (Tul.) P. Royen, *A. kochii* (Engl.) P. Royen, *A. longifolia* (Tul.) P. Royen, and *A. staheliana* (Went) P. Royen). Although distinctions among these species remain to be clarified (Philbrick & Bove, unpublished data), it is clear that mature capsules are required to distinguish species.

Apinagia pusilla Tul., Ann. Sci. Nat., Bot., sér. 3, 11: 99. 1849. TYPE: Guyana. s. loc., s.d., *R. Schomburgk s.n.* (holotype, K).

Schomburgk s.n. includes leaves, segments of prostrate stems, and post-anthesal flowers, but lacks mature capsules. Post-anthesal flowers display stigmas that are flattened, the margins of which are continuous with the winglike medial rib of each valve; these are features of *Rhyncholacis*. Mature capsules are required for identification of species of *Rhyncholacis*; consequently, this species is considered dubious.

Lacis membranacea Bong., Mém. Acad. Imp. Sci. Saint-Pétersbourg, Sér. 6, Sci. Math., Seconde Pt. Sci. Nat. 3(2): 76, tab. 3. 1835. *Apinagia membranacea* (Bong.) Tul., Ann. Sci. Nat., Bot., sér. 3, 11: 99. 1849. *Neolacis membranacea* (Bong.) Wedd., Prodr. [A. P. de Candolle] 17: 64. 1873. TYPE: Brazil. São Paulo: Avanhandava River, Tietê tributary, "Brasilia, Guayandába," s.d., *L. Riedel 391* (holotype, LE not seen; isotypes, B, BM, G, GH, K, L, NY, P, S, U).

Type materials (*Riedel 391*) comprise prominent prostrate stems and ample mature capsules with five non-suture ribs per capsule valve. Leaves are lacking. Stem form and rib number equate to *Wettsteiniola* Suess. (cf. Royen, 1951; Tur, 1975), not *Apinagia* s. str. (cf. Tippery et al., 2011). Species of *Apinagia* s. str. have three non-suture ribs per capsule valve. Royen (1951: 30) noted that *A. membranacea* and *A. guairaensis* Fiebrig (not considered here) may belong in *Wettsteiniola*, but lacked sufficient material on which to base a decision. The absence of complete tepals, however, does not allow confident placement of *Riedel 391* into any current species of *Wettsteiniola* (*W. accorsii* (Toledo) P. Royen, *W. apipensis* Tur, *W. pinnata* Suess.) nor does it support recognition of a distinct species. Consequently, this species is considered dubious.

Marathrum pauciflorum Tul., Ann. Sci. Nat., Bot., sér. 3, 11: 94. 1849. TYPE: Guyana. s. loc., s.d., *R. Schomburgk 556* (holotype, P; isotypes, CGE not seen, F, G, GH, K, L).

Duplicates of *Schomburgk 556* include prostrate stems and flowers. Although capsules are immature, they show features of *Rhyncholacis* (flattened stigmas that are continuous with winglike medial ribs). Because mature capsules are lacking, however, it is not possible to place these collections into a specific species of *Rhyncholacis*. Consequently, the species is considered dubious.

Other Nomenclatural Issues

The following represents clarification of the location of holotype materials for two species.

Ceratolacis erythrolichen (Tul. & Wedd.) Wedd.

Royen (1954) reported the holotype of *Ceratolacis erythrolichen* to be in P, although Philbrick et al. (2004) stated that it could not be located. The holotype in P (*Weddell s.n.* [barcode] P00723694) has since been located and is composed of 10 rocks with attached plants, as well as detached fragments. The holotype is vegetative, lacking flowers and fruits. See Philbrick et al. (2004) for more discussion.

Castelnavia monandra Tul. & Wedd.

Royen (1954) reported the type of *Castelnavia monandra* to be in P. Philbrick et al. (2009) indicated that the type was not located in P, although a fragmentary specimen was located in C. Philbrick et al. (2009) selected a neotype. The holotype in P (*Weddell s.n.* [barcode] P02441297) has subsequently been located. The specimen includes stems, leaves,

flowers (in bud and at anthesis), and mature capsules. See Philbrick et al. (2009) for additional discussion.

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The First Fossil Flowers of Bignoniaceae (Lamiales): *Catalpa hispaniolae* sp. nov. in Dominican Republic Amber

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Abstract. Two fossil flowers in mid-Tertiary amber from the Dominican Republic are described as *Catalpa hispaniolae* Poinar sp. nov. (Bignoniaceae). Their placement in the genus *Catalpa* Scop. is based on the following characters: flowers hypogenous, gamopetalous, zygomorphic, bisexual with a sessile ovary and single filiform style; calyx composed of two cup-shaped sepals; corolla bilabiate with five united petals; and two fertile stamens with oblong anthers consisting of divergent locules dehiscing via longitudinal slits. These flowers can be distinguished from extant members of the genus by the smaller calyx and corolla and lack of staminodia. These specimens represent the first definite fossil flowers of the Bignoniaceae.

Key words: Amber, Bignoniaceae, Caribbean, *Catalpa*, Dominican Republic, paleobotany.

Flowers in amber from the Dominican Republic reveal Neotropical plant groups that existed in Hispaniola during the mid-Tertiary. Among these fossils are representatives of the families Fabaceae, Arecaceae, Poaceae, Chrysobalanaceae, Lauraceae, Meliaceae, Burseraceae, Myristaceae, Rhamnaceae, and Ticodendraceae (Chambers & Poinar, 2014). The present study reports the first fossil flowers of the family Bignoniaceae.

The Bignoniaceae, which occur as trees, shrubs, and lianas, comprise some 827 species in 82 genera arranged in at least eight tribes or clades (Lohmann & Ulloa, 2006). Aside from a few species in Africa and Asia, the greatest diversity occurs in South America, centered in Brazil (Gentry, 1980). Using sequences from the chloroplast genes *rbc*L and *ndh*F, after excluding *Paulownia* Siebold & Zucc. and *Schlegelia* Miq., the family was considered to be monophyletic and included eight major clades, some of which correspond to previously circumscribed tribes (Spangler & Olmstead, 1999; Olmstead et al., 2009).

The genus *Catalpa* Scop. was included within the clade Catalpeae DC. ex Meisn., along with *Chilopsis* D. Don, 1823 (Gentry, 1992; Li, 2008). *Catalpa* is characterized by the presence of only two stamens in contrast to four stamens that are present in most other Bignoniaceae as well as in *Chilopsis* (Gentry, 1992). In the New World, *Catalpa* consists of four species in the Greater Antilles (section *Macrocatalpa*) and two in eastern North America (section *Catalpa*) (Gentry, 1992; Li, 2008; Olmstead et al., 2009). The fossil species from the Dominican Republic described here indicate that *Catalpa* already occurred in the Caribbean in the mid-Tertiary.

Methods

The fossil flowers occurred in amber pieces that originated from La Búcara mine in the northern mountain range (Cordillera Septentrional) of the Dominican Republic between Puerto Plata and Santiago. Amber from mines in this region was produced by *Hymenaea protera* Poinar, 1991 (Fabaceae), and based on the recovered biota, the original habitat was characterized as a tropical moist forest (Poinar & Poinar, 1999).

Dating of Dominican amber is controversial, ranging from 20 to 15 million years ago (Ma) based on Foraminifera (Iturralde-Vinent & MacPhee, 1996) and 45 to 30 Ma based on coccoliths (Cêpek in Schlee, 1990). These are minimum ages since most of the amber was secondarily deposited in turbiditic sandstones of the Upper Eocene to Lower Miocene Mamey Group (Draper et al., 1994), and the length of time it took to redeposit the amber is unknown.

Observations and photographs of the fossil flowers were made with a Nikon SMZ-10 R stereoscopic microscope (Nikon, Tokyo, Japan) and Nikon Optiphot compound microscope with magnifications up to 800×. Helicon Focus Pro X64 (HeliconSoft, Kharkov, Ukraine) was used to stack photos for better clarity and depth of field.

Morphological features of the fossil flowers were compared with blooms of *Catalpa bignonioides* Walter in Corvallis, Oregon, during the months of May and June 2015.

Taxonomy

The two fossil flowers described below are in separate pieces of Dominican amber from La Búcara

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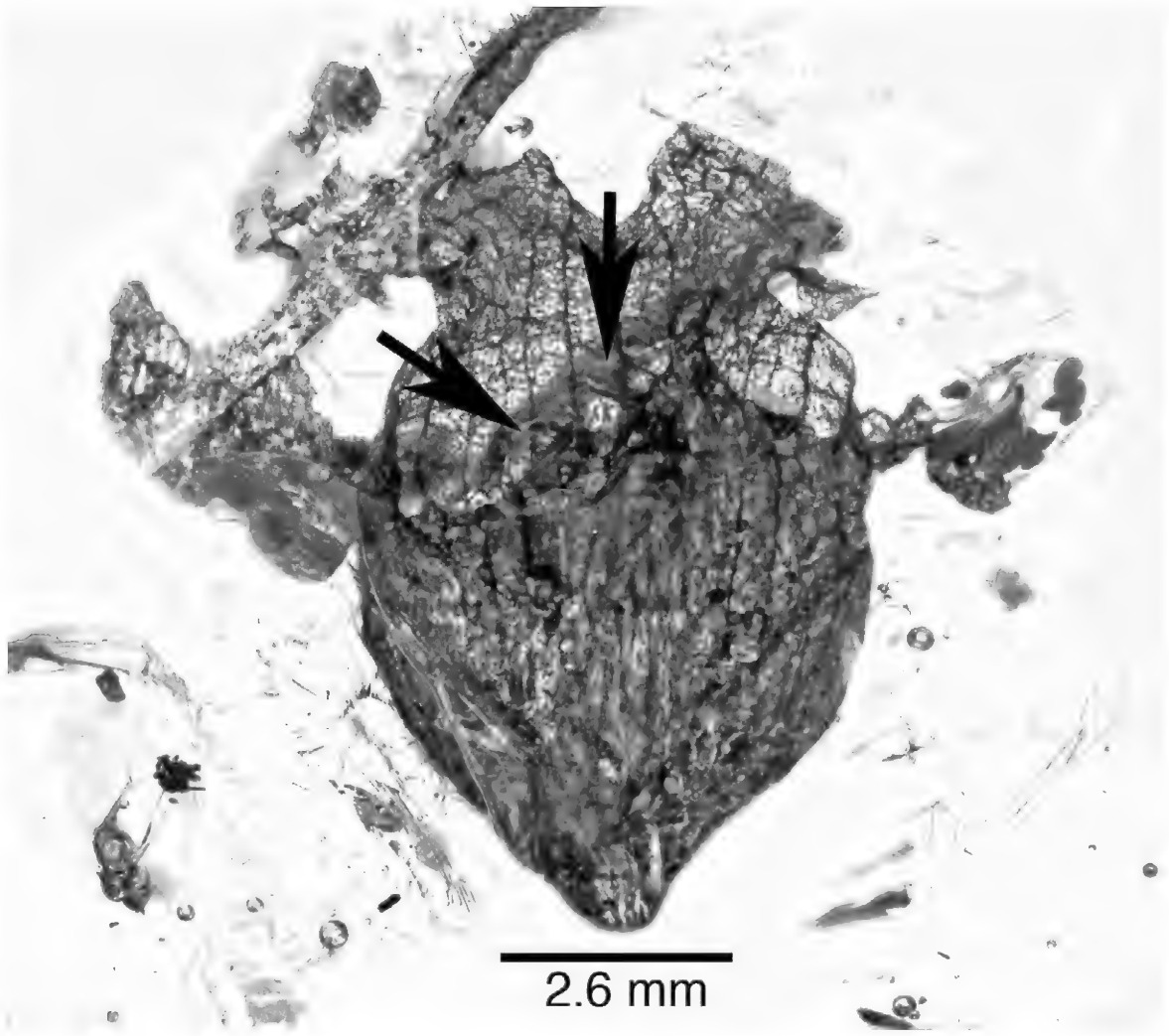

Figure 1. Front view of specimen A (holotype) of *Catalpa hispaniolae* Poinar in Dominican amber.

mine. Both fossils share similar morphological features and are considered to represent the same species. Specimen A (holotype) includes a corolla tube with attached anthers. While specimen B (paratype) is complete, the corolla is partially desiccated and the anthers are not visible. Both specimens show evidence of insect damage.

Order. Lamiales.

Family. Bignoniaceae.

Tribe. Catalpeae DC. ex Meisn.

Genus. *Catalpa* Scop., 1777.

Species. **Catalpa hispaniolae** Poinar, sp. nov. Figures 1–5.

Holotype (SD-9-54A) and paratype (SD-9-54B). Both specimens are from La Búcara amber mine in the northern mountain range (Cordillera Septentrional) of the Dominican Republic (DD latitude and longitude: 71′23″ by 19′34″). Specimens are presently deposited in the Poinar amber collection (PAC) maintained at Oregon State University, Corvallis, Oregon. Final depository will be the California Academy of Sciences, San Francisco.

Type locality. La Búcara amber mine in Altimira facies of the El Mamey Formation in the Cordillera Septentrional of the Dominican Republic (DD 71′23″ by 19′34″).

Etymology. The specific name indicates the geographical location of the fossil.

Diagnosis. Many floral features of *Catalpa hispaniolae*, such as the shape of the floral tube (Figs. 1, 2) and calyx (Figs. 3, 4) and structure and configuration of the anthers (Fig. 5), are similar to those of extant members of the genus. *Catalpa hispaniolae* can be separated from the four known Neotropical species, which are restricted to the Greater and Lesser Antilles (Gentry, 1992), by the combination of the following characters: smaller calyx size (length and width), smaller corolla length, and absence of staminodia (see Table 1). Both North American species (*C. speciosa* (Warder) Engelm. and *C. bignonioides* Walter) have larger flowers and distinct staminodia.

Description. Flowers perfect, medium-sized; calyx composed of 2 broadly ovate, faintly apiculate, lepidote lobes 3.2–3.5 mm in length and 2.3–2.5 mm in greatest width; corolla sympetalous, membranous, tube widest in middle, 2-labiate, with upper lip 2-lobed and lower lip 3-lobed; length of corolla, 9.5–13 mm; width of corolla tube, 9–12 mm: fertile stamens 2, inserted near base of corolla tube; filaments flattened, anthers oblong, each with 2 divergent

Figure 2. Front view of specimen A (holotype) of *Catalpa hispaniolae* Poinar in Dominican amber with back lighting, outlining the two stamens (arrows show filaments).

locules dehiscing via longitudinal slits; length of thecae, 1.6 mm; staminodia absent; ovary sessile; style single, filiform; pollen circular to subcircular.

Comments. Placement in the genus *Catalpa* is based on the 2-parted calyx, presence of only two fertile stamens with flat filaments and anthers with two divergent locules dehiscing by longitudinal slits. The presence of only two fertile stamens is also found in the species *Tanaecium caudiculatum* (Standl.) L. G. Lohmann (tribe Bignonieae) (Lohmann & Taylor, 2014), a species formerly placed in the monotypic genus *Pseudocatalpa* A. H. Gentry (Lohmann, 2004). This species occurs in wet forest vegetation in Mexico (Oaxaca, Veracruz), Belize, and Guatemala (Lohmann & Taylor, 2014) and is characterized by a widely open 5-parted calyx and triangular staminodia (Gentry, 1973). Several seeds closely resembling those of extant *Catalpa* spp. were recovered from amber collected from the same mine (La Búcara) as the flowers. These seeds are oblong and flat and have tufts of long hairs protruding from each end (Fig. 6A). They closely resemble those of the extant North American species *C. bignonioides* (Fig. 6B). While the fossil seeds in Dominican amber provide further evidence of *Catalpa* spp. in the Dominican amber forest, it is not possible to definitely equate them with *C. hispaniolae*.

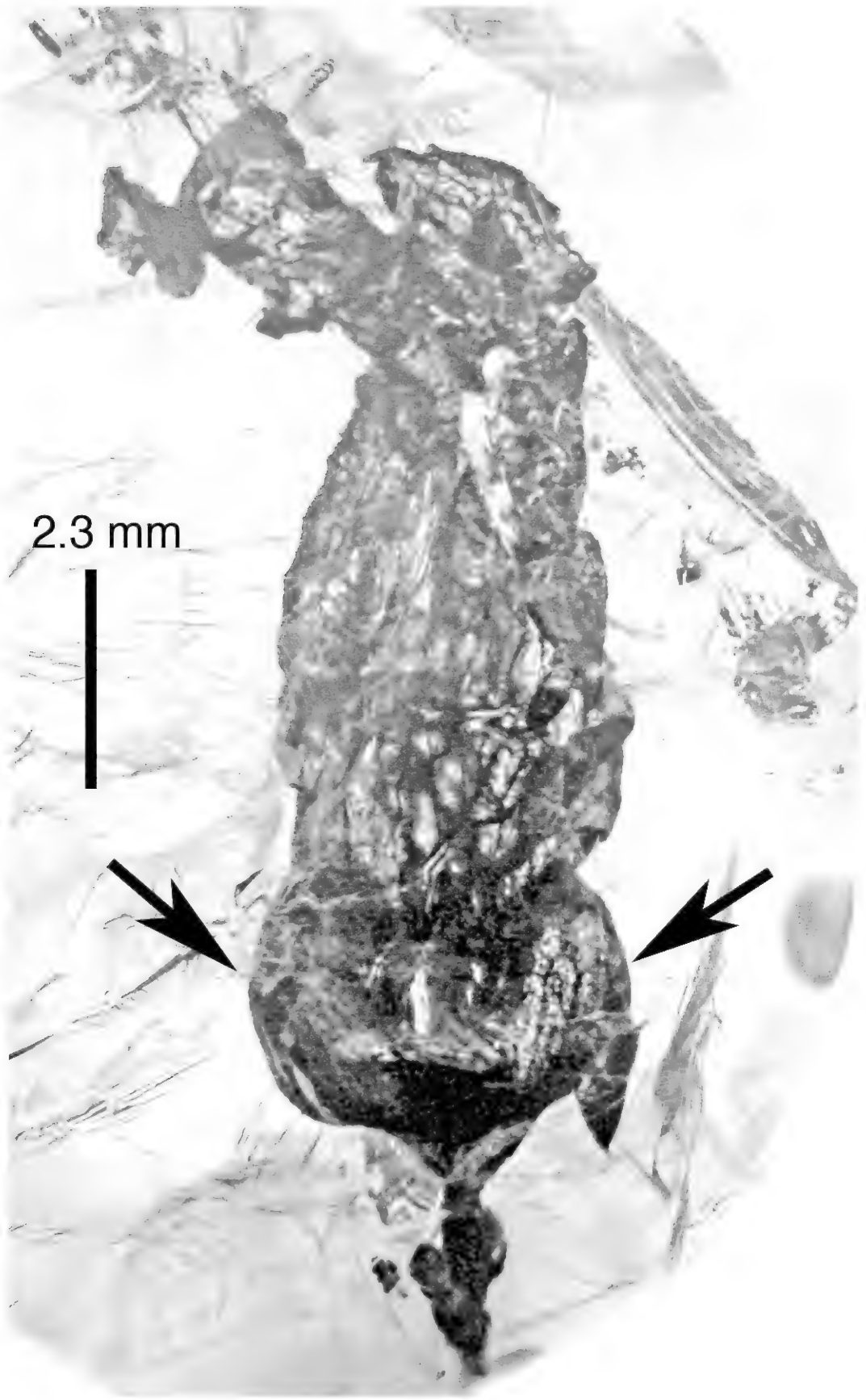

Figure 3. Front view of specimen B (paratype) of *Catalpa hispaniolae* Poinar in Dominican amber. Arrows show calyx lobes.

Discussion

Fossil bi-winged seeds of *Catalpa* from Tertiary deposits in Oregon (U.S.A.), France, Germany, and Japan suggest that the genus had a much more extensive distribution in the past (Paclt, 1952; Manchester, 1999; Olmstead, 2013).

In his synopsis of the genus, Paclt (1952) considered *Catalpa* as one of the oldest lineages of the family Bignoniaceae based on his analysis of fossil seeds, fruits, and flowers of *Catalpa* from the French Eocene. However, the fossil flowers treated as *C. tenuiloba* (Saporta) Paclt (Gentry, 1992) cannot be placed with certainty in the Bignoniaceae. Additional fossil leaves described as *C. crassifolia* Newberry, 1868 were later shown to belong to *Paranymphaea crassifolia* (Newberry) Berry, 1924 in the Nymphaeaceae (Paclt, 1952). Accepted *Catalpa* fossils are Tertiary leaves, fruits, and seeds (Wehr & Hopkins, 1994; Meyer & Manchester, 1997; Pigg & Wehr, 2002; Wang et al., 2013). No fossil flowers of *Catalpa* or the Bignoniaceae have been reported to date.

Figure 4. Detail of base of specimen B (paratype) of *Catalpa hispaniolae* Poinar in Dominican amber showing cuplike calyx lobes.

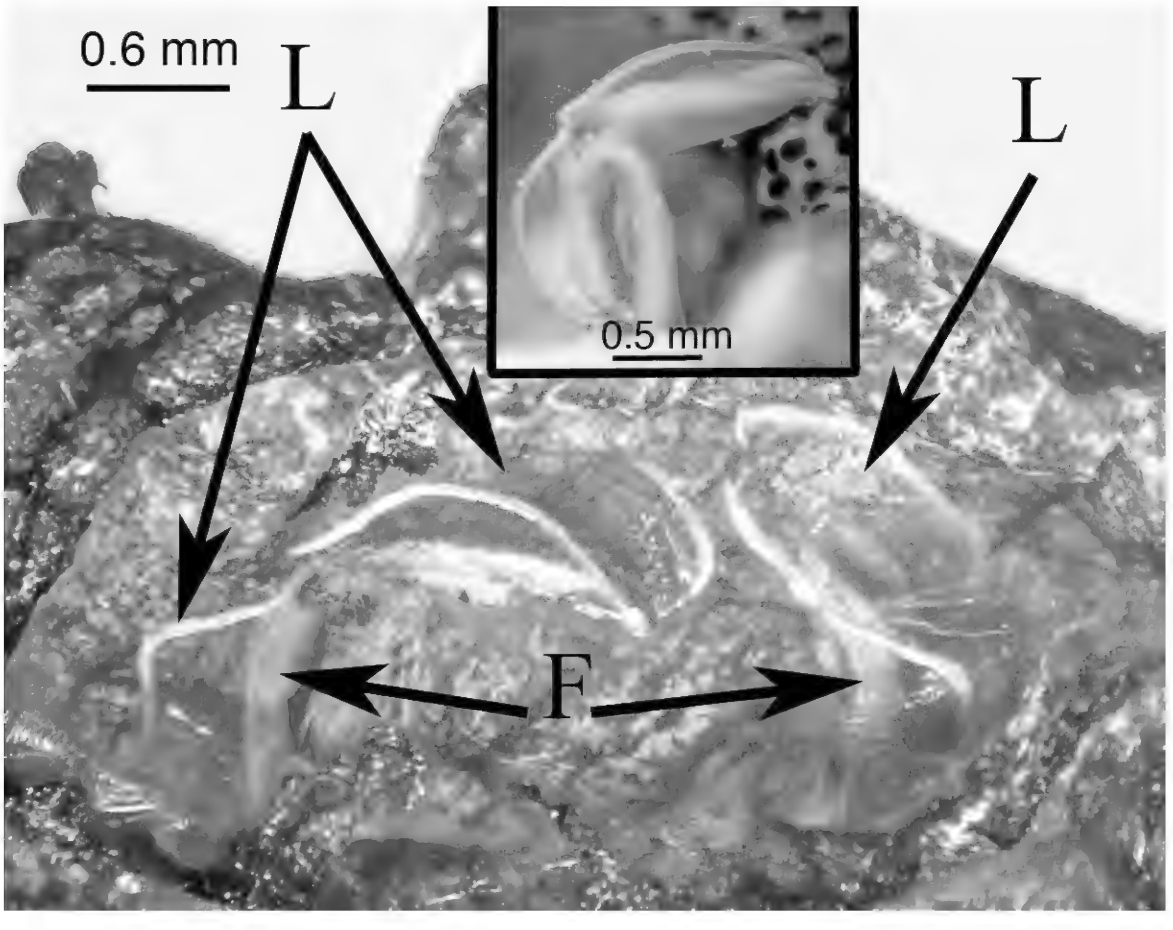

Figure 5. Anthers of specimen A (holotype) of *Catalpa hispaniolae* Poinar in Dominican amber. Inset shows anther of the extant *C. bignonioides* Walter for comparison. L, locules; F, filaments.

Table 1. Measurements of floral structures of the four extant species of Caribbean *Catalpa* Scop. sect. *Macrocatalpa* from Gentry (1992), along with those of the fossil, *C. hispaniolae* Poinar. All measurements are in millimeters. N = not present.

Species	Calyx length	Calyx width	Corolla length	Thecae length	Staminodia
C. brevis	4–7	5–7	15	2	N
C. longissima	4–7	4–5	14–15	1.5	3
C. macrocarpa	4–7	3–6	10–20	1.5	3
C. purpurea	6–10	6–7	25–30	1.6	?
C. hispaniolae	3.2–3.5	2.4	9.5–13	1.6	N

When the *Catalpa* lineage appeared in the Greater Antilles it was difficult to determine, as is the position of *C. hispaniolae* within *Catalpa*. The only molecular phylogeny of *Catalpa* available to date (Li, 2008) indicates the West Indian species of *Catalpa* (section *Macrocatalpa*) are derived from the continental species.

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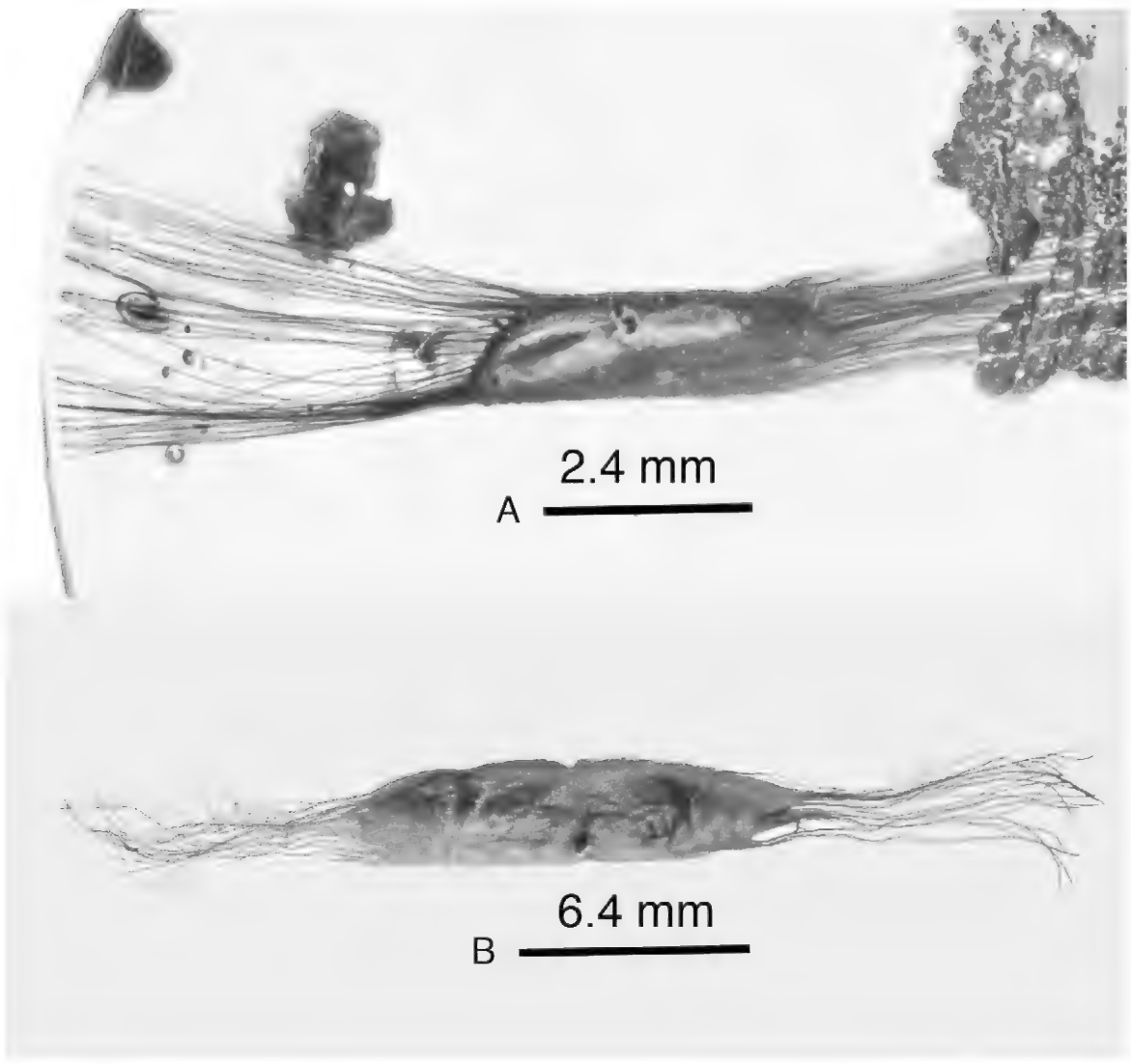

Figure 6. —A. Seed with terminal hair tufts in Dominican amber (PAC accession #D-9-107). —B. Seed of the extant *Catalpa bignonioides* Walter.

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A New Species of *Casimiroa* (Rutaceae) from Nicaragua and Costa Rica

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Abstract. A new species, *Casimiroa dura* A. Pool & Coronado, is described from Nicaragua and Costa Rica. The new species is most similar to *C. sapota* Oerst., but differs in its fruit's epicarp, which is hard, thick, and brittle.

Key words: *Casimiroa*, cochitzapotl, Costa Rica, iztactzapotl, matasano, matasano del pacifico, Nicaragua, tapaculo, white sapote, zapote blanco, zapote somnifero.

Casimiroa La Llave is a genus in the Rutaceae of about nine species and is known from Texas to Costa Rica, with its center of diversity in Mexico. The species are unarmed, functionally dioecious (Chiang, 2001) or androdioecious, trees or shrubs, with alternate and palmately compound leaves with (one)three to five (seven) leaflets, inflorescence panicles with actinomorphic flowers, the flowers with the sepals four or five, connate to various degrees to form deeply lobed to cupuliform and nearly entire calyx, the petals four or five, free, valvate, oblong to slightly elliptic or slightly obovate, green to white or yellow, the stamens (staminodes in pistillate flowers, Chiang, 2001) equal to the number of petals, and the superior ovaries (variously developed in staminate flowers) with one to five locules, axillary ovules, and a large stigma, and drupaceous fruits with one to five large pyrenes each with one seed. Two species, *C. sapota* Oerst. and *C. edulis* La Llave, are commonly cultivated for their large, sweet, and soft fruits and *C. edulis* also for its numerous medicinal uses (Henry & Vera-Caletti, 2010).

Casimiroa dura A. Pool & Coronado, sp. nov. TYPE: Nicaragua. Chontales: 1 km before El Zancudo, rocky hilltop with disturbed dry forest, 12°21′17″N 85°15′52″W, 370 m, 16 Jan. 2010, *W. D. Stevens & E. Duarte M. 28973* (holotype, MO; isotype, HULE not seen). Figures 1, 2A, B.

Diagnosis. *Casimiroa dura* A. Pool & Coronado differs from *C. sapota* Oerst. by its fruit with an epicarp 4–5 mm thick, hard, and brittle (vs. 0.25–1.0 mm thick, delicate, and yielding) and its leaflets with the abaxial surface glabrous, except for the puberulent midribs with trichomes to 0.03 mm (vs. abaxial surface totally glabrous to pubescent with trichomes (0.1–)0.2–0.5 mm borne densely overall or restricted to midrib and secondary vein axils).

Trees (8)15–20 m, bark slightly rough, white; young branches glabrous or minutely puberulent, lenticellate and irregularly ribbed, the ribs flaking. Leaves (3)4- or 5-foliolate, leaflets wide-elliptic to obovate, 9–31 × (4.5)5–16 cm, membranaceous to chartaceous, lateral veins 9 to 13 pairs diverging at a (40)45°–60(65)° angle from the midrib, adaxial surface puberulent, glabrous, or glabrous with a puberulent midrib, abaxial surface puberulent only on the midrib with trichomes to 0.03 mm, leaflet base cuneate, sometimes inequilateral, margin inconspicuously crenulate, slightly revolute, apex shortly acuminate, ultimately emarginate; petiolules 3–15 mm, 1/50–1/12 length of the leaflet, puberulent; petioles 7.5–27 cm. Inflorescences axillary and terminal, thyrses or panicles with 2 or 3 thyrsiform branches from near base, minutely puberulent with trichomes to ca. 0.03 mm, or with somewhat longer trichomes near base, thyrse or thyrsiform branches 5–7.5 cm, peduncle of thyrse or thyrsiform branches 10–20 mm; bracteoles 3 at base of pedicels, ca. 0.25 mm, covered with tuft of trichomes; pedicels 2.5–6 mm, glabrous. Flowers staminate or seemingly perfect, 4- or 5-merous, glabrous, green; calyx weakly lobed, repand or entire, 0.5–1 mm; petals 2.5–3.5 × 1–2 mm, coriaceous; stamens with filaments 1.5–2.5 × 0.25–0.5 mm and anthers 1–1.5 mm; pistillode in staminate flowers a fleshy raised disc, glabrous; ovary glabrous, stigma sessile with 3 to 5 lobes, the lobes 0.75–1 mm. Fruits drupaceous, globose, 3–5 cm diam., glabrous, fresh epicarp whitish gray or green, ± covered with numerous lenticels, hard and brittle, breaking into pieces under pressure, mesocarp white and creamy, sweet, dried epicarp 4–5 mm thick, externally whitish gray or brown, commonly cracked, internally light brown, irregularly granular, mesocarp pale brown to off-

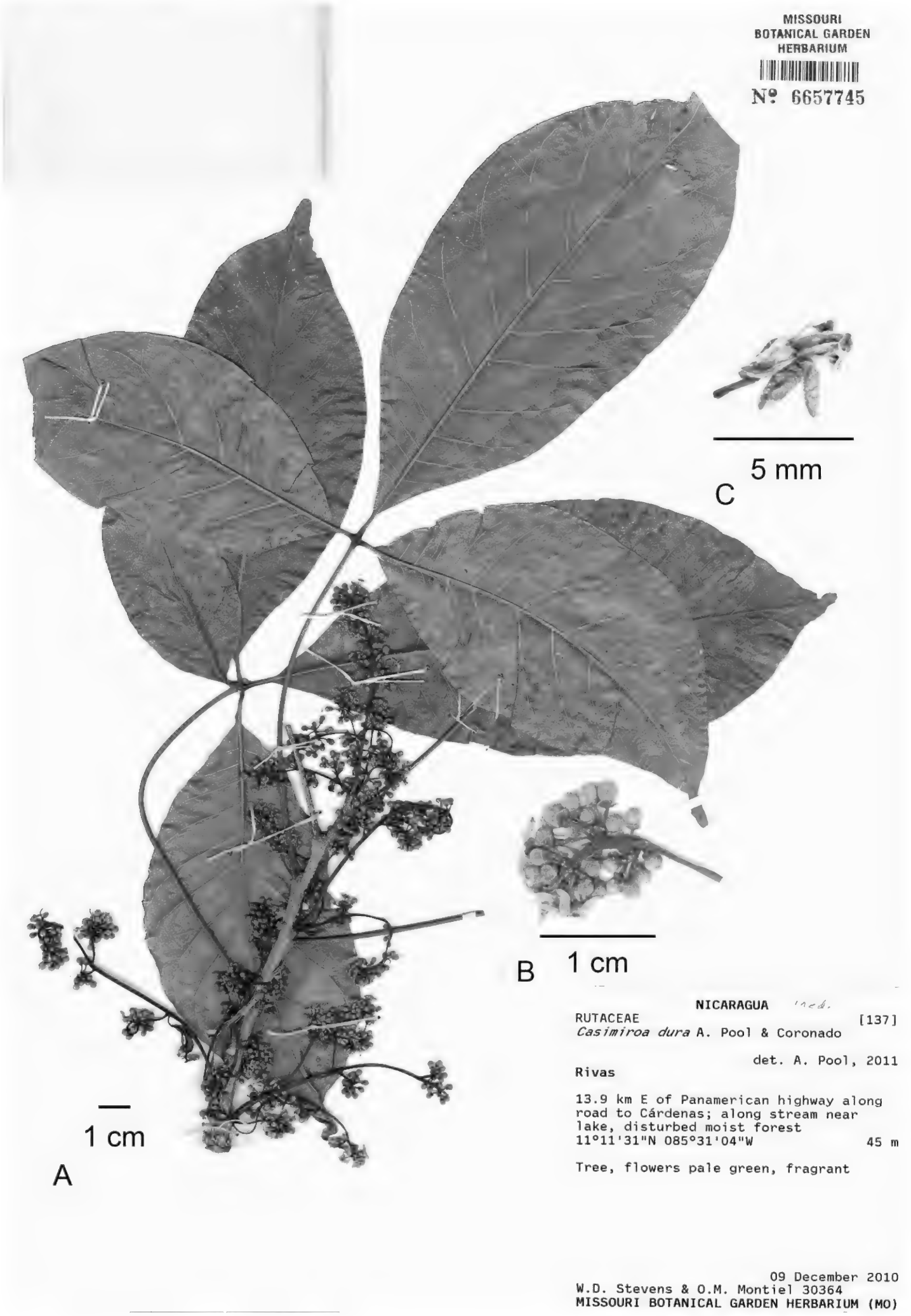

Figure 1. A–C. Paratype of *Casimiroa dura* A. Pool & Coronado (*W. D. Stevens & O. M. Montiel 30364*, MO). —A. Branch with staminate inflorescences. —B. Cluster of staminate flowers. —C. Staminate flower.

white; pyrenes (3)4 or 5, ellipsoidal, 2.2–2.5 × 1–1.5 cm, surface obliquely ridged and somewhat reticulate, acute at base, rounded at apex (the base and apex determined by their orientation within the fruit).

Distribution. *Casimiroa dura* is known from disturbed dry to moist evergreen forests in Nicaragua and Costa Rica, commonly from 45 to 600 m, with one collection at 820 m and one at 1100 m.

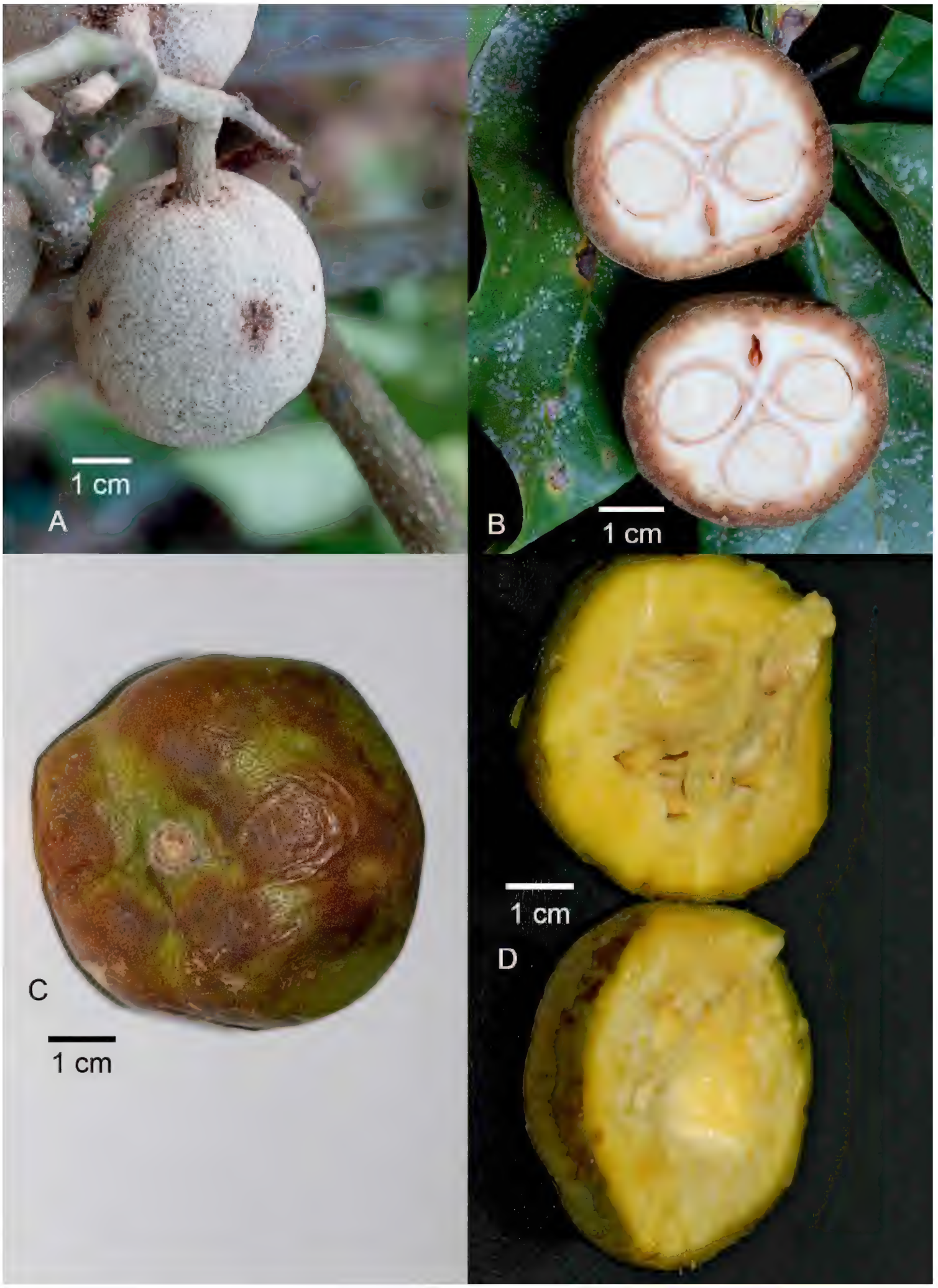

Figure 2. A, B. *Casimiroa dura* A. Pool & Coronado. —A. Fresh fruit. —B. Cross section of fresh fruit. C, D. *Casimiroa sapota* Oerst. —C. Fresh fruit. —D. Cross section of fresh fruit. A, B from the holotype *W. D. Stevens & E. Duarte M. 28973* (MO). C, D from *I. Coronado & R. M. Rueda 5202* (MO).

IUCN Red list category. *Casimiroa dura* is Data Deficient (DD), according to IUCN (2012) criteria. It is distributed from western Nicaragua to northwestern Costa Rica. We have seen 14 collections made between 45 and 1100 m. Its extent of occurrence (EOO) is ca. 21,000 km^2 and the area of occurrence (AOO) is 90 km^2, with 27% of the collections made outside of protected areas and 82% made outside of pristine areas.

Phenology. *Casimiroa dura* has been collected in flower from October to December (early dry season) and in mature fruit from December to February (dry season).

Discussion. *Casimiroa dura* differs most notably from *C. sapota* in its fruit that has a hard epicarp, 4–5 mm thick (Fig. 2A, B), that breaks into pieces under pressure (much like those of *Randia nicaraguensis* Lorence & Dwyer, *Capparis pachaca* Kunth, and *Bonellia nervosa* (C. Presl) B. Ståhl & Källersjö). The fruit of *Casimiroa sapota*, however, has a delicate epicarp, 0.25–1.0 mm thick (Fig. 2C, D), that yields and squishes under pressure (like that of a tomato). The mesocarp of *C. dura* is white (Fig. 2B) when fresh and that of *C. sapota* is yellow, yellow-green, green-yellow (Fig. 2D), or yellow-orange (W. D. Stevens and B. Hammel, pers. comm.). The abaxial surface of the leaflet of *C. dura* always bears minute perpendicular trichomes to 0.03 mm on the midrib and is otherwise glabrous, whereas that of *C. sapota* is totally glabrous or with trichomes (0.1)0.2–0.6 mm borne densely overall to restricted to the midrib and leaf vein axils. Only three flowering specimens of *C. dura* have been seen; the flowers of all three are glabrous, while those of *C. sapota* have trichomes on the calyces (primarily along the margin of the lobes) and almost always on the adaxial surface of the petals.

Casimiroa sapota is widely cultivated in the Neotropics for its large, sweet-flavored fruits, but is apparently native to Chiapas (Mexico), Guatemala, Nicaragua, Costa Rica, and El Salvador. It is generally found between 900 and 1800 m (and occasionally between 400 and 900 m), but *C. dura*, which is not known to be cultivated, is generally found between 45 and 600 m (rarely to 1100 m).

Casimiroa dura is commonly called "Matasano del Pacifico" in Nicaragua and *C. sapota* is called "Matasano" in Nicaragua, and "Matasano, Tapaculo, and Zapote Blanco" in Costa Rica (Jiménez, 2014: 787). *Casimiroa dura* is treated as *Casimiroa* sp. A in Jiménez (2014: 788), where the mesocarp is described as "granuloso-fibroso." The latter is due to error on the part of the first author of this paper based on a third-hand report on the label of *W. D. Stevens & O. M. Montiel J. 26782* (MO), "said to be similar to 'Matasano' but with a hard brown shell on fruit and the pulp somewhat fibrous and grainy." The pulp (Stevens, who has eaten the fruit, pers. comm.) is creamy and not at all grainy or fibrous.

Because *Casimiroa sapota* itself is frequently confused with *C. edulis* (for which common names include white sapote, zapote blanco, zapote somnifero, cochitzapotl, iztactzapotl; see Henry & Vera-Caletti, 2010), which is also widely cultivated for its large, sweet fruits, it is often difficult to know whether these two species are cited by the correct names in published studies. As recognized here, *C. edulis* differs from *C. sapota* (and *C. dura*) in its relatively longer petiolule (1/4 to 1/3 length of leaflet and more variable in cultivars vs. to ca. 1/10 length of leaflet) and its calyx with deltoid and acute to lanceolate and acuminate lobes (vs. repand, weakly and obtuse-lobed, or obtuse-cuspidate in *C. sapota* and weakly lobed, repand, or entire in *C. dura*). The fruit of *C. edulis* is very similar to that of *C. sapota* in most aspects but reportedly has the ripe mesocarp white or slightly yellow (Martínez, 1951; Henry & Vera-Caletti, 2010) versus yellow, yellow-green, green-yellow, or yellow-orange (W. D. Stevens and B. Hammel, pers. comm.). *Casimiroa edulis* differs from the other two species also in its geographic distribution; natural populations have been reported only from north-central Mexico (Henry & Vera-Caletti, 2010).

Paratypes. COSTA RICA. **Guanacaste:** Liberia, Parque Nacional Guanacaste, Cuenca del Tempisque, sector Cacao, alrededor del Río Góngora, 10°53′21″N 085°28′32″W, 600 m, 28 Apr. 2000, *L. Acosta, V. H. Ramírez, D. A. Soto, G. Soto & G. Sancho 997* (INB not seen, MO); La Cruz, Parque Nacional Guanacaste, estación Maritza, 10°55′38″N 085°29′38″W, 1100 m, 1 Mar. 1992, *R. Espinoza 211* (INB not seen, MO). NICARAGUA. **Boaco:** Mombachito 1, Kilimanjaro, Finca Ramón Barrera Rosales, 820 m, 8 Mar. 2006, *M. E. Juaréz 39* (HULE not seen, MO). **Chinandega:** Municipio El Viejo, Reserva Natural Volcán Cosigüina, comunidades El Jicarito, El Chorro, Elena María, 12°53′47″N 087°31′37″W, 50 m, 19 July 2005, *R. Rueda & B. Sánchez 18091* (HULE). **Chontales:** along rd. to Betulia, 2.5 km after Estero del Caballo & 5.1 km before Betulia, roadside, 12°17′07″N 085°14′59″W, 440 m, 18 Jan. 2010, *W. D. Stevens 29017* (HULE not seen, MO); along Cuapa–El Zancudo rd., 1.7 km SW of El Silencio, roadside in cultivated fields, 12°19′48″N 085°19′40″W, 540 m, 30 Dec. 2010, *W. D. Stevens & O. M. Montiel J. 30834* (HULE not seen, MO); 1 km before El Zancudo, rocky hilltop with disturbed dry forest, 12°21′17″N 085°15′52″W, 370 m, 18 Oct. 2011, *W. D. Stevens & O. M. Montiel J. 31900* (HULE not seen, MO); N of Cuapa, 0.5 km along W fork toward Camoapa passing E of Cerro Oluma, moist forest patch, 12°18′04″N 085°22′45″W, 530 m, 5 Nov. 2011, *W. D. Stevens 32251* (HULE not seen, MO). **Managua:** El Chocoyero Reserve, just outside entrance, coffee plantations and disturbed semi-evergreen forest, 11°58′45″N 086°15′28″W, 400 m, 24 Dec. 2005, *W. D. Stevens & O. M. Montiel J. 26782* (HULE not seen, MO); Ticuantepe, Reserva El Chocoyero, 11°58′54″N 086°15′44″W, 500 m, 24 Dec. 2009, *S. Holt E5056* (MO); s.d., *S. Holt 911* (MO). **Matagalpa:** 10.0 km NW of Matiguás–Muy Muy hwy. along rd. to El Jobo, near Santa Cruz, moist forest scrap along river, 12°51′17″N 085°34′02″W, 345 m, 25 Jan. 2014, *W. D. Stevens 34480* (HULE). **Rivas:** Cárdenas, bosque seco tropical, 11°12′N 085°31′W, 45–50 m, 15 Feb. 1983, *J. C. Sandino 4077* (HNMN, not seen, MO); 13.9 km E of Panamerican hwy. along rd. to Cárdenas, along stream near lake, disturbed moist forest, 11°11′31″N 085°31′04″W, 45 m, 9 Dec. 2010, *W. D. Stevens & O. M. Montiel J. 30364* (HULE, MO).

Acknowledgments. We thank the curators of G and C for scans of type material of *Casimiroa edulis* and *C. sapota*, respectively, and W. D. Stevens and B. Hammel for answering numerous questions about fresh material of *C. sapota* and/or *C. dura*, O. M. Montiel for the use of her excellent photographs of fruiting material of *C. dura*, Fred Keusenkothen for preparing the figures, and Burgund Bassüner for help in calculating the IUCN Red List category.

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Rubiacearum Americanarum Magna Hama Pars XXXV: The New Group *Palicourea* sect. *Nonatelia*, with Five New Species (Palicoureeae)

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Abstract. Many of the species classified in *Psychotria* L. subg. *Heteropsychotria* Steyerm. have been shown to belong to *Palicourea* Aubl. (Rubiaceae, Palicoureeae), including the species of *Psychotria* sect. *Nonatelia* (Aubl.) Müll. Arg., based on morphological and molecular characters. Accordingly, these along with several additional species are transferred to the new section *Palicourea* sect. *Nonatelia* (Aubl.) C. M. Taylor. This new section includes 26 species found from southern Mexico to Trinidad and northern Argentina, and is diagnosed by its stipule morphology, distinctive leaf venation, and inflorescence arrangement. This new section includes *Palicourea racemosa* (Aubl.) Borhidi, *Palicourea woronovii* (Standl.) C. M. Taylor, Bruniera & Zappi, *Palicourea veracruzensis* (Lorence & Dwyer) Borhidi, and 23 additional species with names newly published here. The following new combinations are made here: *Palicourea amita* (Standl.) C. M. Taylor is based on *Psychotria amita* Standl.; *Palicourea apiculata* (Müll. Arg.) C. M. Taylor is based on *Psychotria apiculata* Müll. Arg.; *Palicourea brevicollis* (Müll. Arg.) C. M. Taylor is based on *Psychotria brevicollis* Müll. Arg.; *Palicourea carnosocarpa* (Dwyer & M. V. Hayden) C. M. Taylor is based on *Psychotria carnosocarpa* Dwyer & M. V. Hayden; *Palicourea eggersii* (Standl.) C. M. Taylor is based on *Psychotria eggersii* Standl.; *Palicourea fissistipula* (Müll. Arg.) C. M. Taylor is based on *Psychotria fissistipula* Müll. Arg.; *Palicourea forsteronioides* (Müll. Arg.) C. M. Taylor is based on *Psychotria forsteronioides* Müll. Arg.; *Palicourea malaneoides* (Müll. Arg.) C. M. Taylor is based on *Psychotria malaneoides* Müll. Arg.; *Palicourea mamillaris* (Müll. Arg.) C. M. Taylor is based on *Psychotria mamillaris* Müll. Arg.; *Palicourea minutiflora* (Müll. Arg.) C. M. Taylor is based on *Psychotria minutiflora* Müll. Arg.; *Palicourea obconica* (Müll. Arg.) C. M. Taylor is based on *Psychotria obconica* Müll. Arg.; *Palicourea octocuspis* (Müll. Arg.) C. M. Taylor is based on *Psychotria octocuspis* Müll. Arg.; *Palicourea soejartoi* (C. M. Taylor) C. M. Taylor is based on *Psychotria soejartoi* C. M. Taylor; *Palicourea stenostachya* (Standl.) C. M. Taylor is based on *Psychotria stenostachya* Standl.; *Palicourea subfusca* (Müll. Arg.) C. M. Taylor is based on *Psychotria subfusca* Müll. Arg.; *Palicourea tacarcunensis* (Dwyer) C. M. Taylor is based on *Psychotria tacarcunensis* Dwyer; *Palicourea tsakiana* (C. M. Taylor) C. M. Taylor is based on *Psychotria tsakiana* C. M. Taylor; and *Palicourea valerioana* (Standl.) C. M. Taylor is based on *Psychotria valerioana* Standl. Five new species are described here: *Palicourea cajamarcana* C. M. Taylor is found in Andean northern and central Peru and has previously been confused with *Palicourea amita*; *Palicourea dodsoniana* C. M. Taylor is found in lowland western Ecuador and has previously been confused with *Palicourea stenostachya*; *Palicourea locellata* C. M. Taylor is found in Andean eastern Colombia and has unusual tubular stipules and chambered pyrenes; *Palicourea meieri* C. M. Taylor is found in the mountains of Venezuela and has previously been confused with *Palicourea eggersii*; and *Palicourea topoensis* C. M. Taylor is found in Andean Ecuador and northern Peru and has previously been confused with *Palicourea amita*. Lectotypes are designated for three series, *Psychotria* ser. *Stenothyrsae* Müll. Arg., *Psychotria* ser. *Spicatae* Müll. Arg., and *Psychotria* ser. *Stachythyrsae* K. Schum.; for three subseries, *Psychotria* subser. *Quadricuspides* Müll. Arg., *Psychotria* subser. *Fissistipulae* Müll. Arg., and *Psychotria* subser. *Octocuspides* Müll. Arg.; for nine species, *Psychotria brevicollis*, *Psychotria fissistipula*, *Psychotria malaneoides*, *Psychotria minutiflora*, *Psychotria octocuspis*, *Psychotria regnellii* Müll. Arg., *Psychotria schottiana* Müll. Arg., *Psychotria stellaris* Müll. Arg., and *Psychotria trichostyla* Müll. Arg.; and for one variety, *Psychotria malaneoides* var. *glabrescens* Müll. Arg.

Key words: Bolivia, Colombia, Ecuador, IUCN Red List, *Palicourea*, Palicoureeae, Peru, *Psychotria*, Psychotrieae, Rubiaceae, World Flora Online.

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Palicourea Aubl. (Rubiaceae, Palicoureeae; abbreviated as "*Pal.*") comprises several hundred Neotropical species of shrubs and small trees with persistent stipules, animal-pollinated flowers, and blue to purple-black or white, fleshy, drupaceous fruits (Taylor, 1996, 1997a). This genus has long been considered closely related to the pantropical *Psychotria* L. (abbreviated as "*Psy.*"), and these genera have been classified together in the tribe Psychotrieae (e.g., Müller, 1881; Bremer & Eriksson, 2009). However, recent molecular analyses show that this broadly circumscribed tribe Psychotrieae included two distinct clades or evolutionary groups: one comprising *Psychotria* and the other composed of various genera including *Palicourea* (Robbrecht & Manen, 2006; Razafimandimbison et al., 2014). These groups have been separated taxonomically by some recent authors, as informal groups of genera (Andersson, 2002) or as two tribes, Psychotrieae s. str. and Palicoureeae (Robbrecht & Manen, 2006; Razafimandimbison et al., 2014). As the separation between *Psychotria* and *Palicourea* has been clarified, morphological (Taylor, 1996) and molecular (Andersson & Rova, 1999; Nepokroeff et al., 1999; Robbrecht & Manen, 2006; Razafimandimbison et al., 2008, 2014; Paul et al., 2009; Sedio et al., 2013) studies have confirmed also that the Neotropical species traditionally classified in *Psychotria* comprise a heterogeneous group. Some of these species are correctly classified in *Psychotria*, but most of them belong to the tribe Palicoureeae and within this, to several distinct genera. Most of the species of the Neotropical *Psychotria* subg. *Heteropsychotria* Steyerm. do belong to a single evolutionary group, which also includes the species that have been classified in *Palicourea* (Taylor, 1996; Paul et al., 2009; Sedio et al., 2013). This combined Neotropical group, *Palicourea* s.l., is estimated to include ca. 600 species. This article continues the expansion of the circumscription of *Palicourea* (Taylor et al., 2010; Taylor, 2015a, 2015b) via transfer from *Psychotria* to *Palicourea* of the incorrectly classified species. The species included up to now in *Palicourea* are classified in two subgenera and 11 sections (Taylor, 1997a, 2015a, 2015b), and a new section is added here.

Palicourea was long separated from *Psychotria* subg. *Heteropsychotria* based on corolla characters that are related to pollination mode (Steyermark, 1972; Taylor, 1996, 1997a). *Palicourea* and *Psychotria* subg. *Heteropsychotria* are not distinguishable vegetatively or in fruit (Taylor, 1996). In this long-standing taxonomy, *Palicourea* included plants adapted for hummingbird pollination, with brightly colored flowers that are odorless, pedicellate, and well separated from each other in brightly colored lax inflorescences and have relatively large corollas with well-developed, often curved tubes that are swollen at the base. The swollen basal portion of the corollas contains appreciable quantities of nectar that are protected from insects by a ring of stiff trichomes but are accessible to hummingbirds. In contrast, *Psychotria* subg. *Heteropsychotria* included presumably insect-pollinated species, with generally green to white or pale yellow inflorescences and flowers, and fragrant flowers that are generally sessile or shortly separated and smaller. The corollas of these species generally have straight bases and short tubes that allow small insects to access the nectar. However, there is actually extensive variation in inflorescence and corolla form and flower odor within both *Palicourea* and *Psychotria* subg. *Heteropsychotria* (e.g., Taylor et al., 2004), and the classic flower and inflorescence characters do not separate two evolutionarily distinct groups of species. Recent molecular analyses have found phylogenetic relationships in which pollination mode, with its corresponding adaptations, is homoplasious and has changed repeatedly within various Rubiaceae genera (e.g., Nepokroeff et al., 1999; Malcomber & Taylor, 2009; Mouly et al., 2009). Molecular data show a similar pattern in *Palicourea* (Paul et al., 2009; Sedio et al., 2013). In spite of this variation in reproductive characters, the combined group that comprises *Palicourea* plus most of the species of *Psychotria* subg. *Heteropsychotria* is morphologically well delimited by vegetative and fruit characters, and does have strong support from molecular data.

Palicourea in this new, broadened circumscription is characterized by its persistent bilobed stipules; its terminal, laxly paniculiform to densely subcapitate, bracteate to ebracteate, green to brightly colored inflorescences; its generally 5-merous, sessile to pedicellate flowers; its generally inaperturate pollen with thin sexine (Johansson, 1992); and its usually blue to purple-black succulent fruits (Taylor, 1996, 1997a, 2015a; Taylor et al., 2010). In this broadened circumscription, the name *Psychotria* subg. *Heteropsychotria* is a synonym of *Palicourea*. However, the transfer of species from *Psychotria* subg. *Heteropsychotria* to *Palicourea* is not automatic and requires study of each individual species, a process currently in progress (e.g., Taylor et al., 2010; Taylor, 2015a, 2015b). *Psychotria* subg. *Heteropsychotria* was circumscribed based on primarily corolla characters that are widespread and apparently ancestral within its tribe, so this subgenus included a heterogeneous assemblage of species. Many of its species have

recently been separated into the genera *Notopleura* (Benth.) Bremek. (Taylor, 2001a), *Ronabea* Aubl. (Taylor, 2004a), *Margaritopsis* C. Wright (Taylor, 2005; i.e., *Eumachia* DC., Applequist, 2014), *Coccochondra* Rauschert (Taylor, 2011), and *Carapichea* Aubl. (Taylor & Gereau, 2013). Now the remaining species of *Psychotria* subg. *Heteropsychotria* apparently belong to *Palicourea*, but they still need study to confirm this and their relationships within the genus. The genus *Cephaelis* Sw. was previously synonymized with *Psychotria* subg. *Heteropsychotria* (Steyermark, 1972), and its type species now probably belongs to *Palicourea* s.l. (Taylor & Gereau, 2013: 101–104). However, *Cephaelis* as treated by most authors was a systematically heterogeneous group, and many species were incorrectly classified there and do not belong to *Palicourea*.

Our knowledge of *Palicourea* in this new, broadened circumscription is currently restricted by our limited knowledge of its species and species groups. This article is part of ongoing work to inventory and document the species of this genus and organize them into an infrageneric classification (Taylor, 1997a, 2015a, 2015b; Taylor et al., 2010) that can be tested with molecular data and analyzed morphologically. *Palicourea* comprises a large, widespread, and thus significant evolutionary radiation of Neotropical plant species, so understanding aspects of its diversification such as centers of species richness, number of sympatric lineages, reproductive and dispersal biology, and the size, ages, and ranges of its lineages will shed light on general Neotropical plant diversity. All such studies depend on a comprehensive documentation of the component species, part of which is provided here for *Palicourea*.

The Species of *Nonatelia*, *Psychotria* sect. *Nonatelia*, and *Psychotria* ser. *Stenothyrsae*

The genus *Nonatelia* Aubl. originally included six species of *Palicourea* s.l. from French Guiana, and its morphological description contained an internal contradiction: it was described as having two stigmas and five pyrenes. This diagnosis is problematic because in all of these plants the number of stigmas is equal to the number of ovary locules and pyrenes. Five of the species included in *Nonatelia* by Aublet have two stigmas and two pyrenes, while *N. racemosa* Aubl. has five stigmas and five pyrenes. After its description most authors retained all of Aublet's *Nonatelia* species in this genus, in particular Roemer and Schultes (1819) and de Candolle (1830), but a few authors differed. Willdenow (1797) included all of the *Nonatelia* species in *Psychotria*; Persoon (1805–1807) also did not recognize *Nonatelia* and included *N. racemosa*, *N. violacea* Aubl., and *N. paniculata* Aubl. in *Psychotria* and *N. longiflora* Aubl. and *N. lutea* Aubl. in *Palicourea*.

Richard (1830: 206–208) reviewed *Nonatelia* in detail, and considered the 5-locular ovary to be the diagnostic feature of *Nonatelia*. He therefore excluded five of Aublet's species from this genus, because they have bilocular ovaries, and retained in this genus only *N. racemosa*, which has five stigmas, five ovary locules, and five pyrenes. Richard's conclusion is considered here to be a significant alteration of the characters of *Nonatelia* sensu McNeill et al. (2012: Art. 47, Rec. 47A) and therefore an emendation of this genus. *Nonatelia* is thus considered here to be emended by Richard by exclusion of species. No type was designated by Aublet for *Nonatelia*, so Richard's restriction of this genus to only *N. racemosa* is here considered a lectotypification. This contrasts with the conclusion of Farr et al. (1979), who designated *N. officinalis* Aubl. as the lectotype type of this genus (Delprete, 2015). That lectotype selection was not explained by Farr et al., and may have been mechanical because *N. officinalis* was the first of the six species listed, and, although it does not agree completely with the protologue characters, this was not noted. Richard's selection has priority of date over the work of Farr et al., however, and is convincing because Richard studied the protologue characters and emended the genus so that the characters of the genus and the type species agree. Richard's emended circumscription of *Nonatelia* was accepted by some subsequent authors (Müller, 1881; Bremekamp, 1934).

Most subsequent authors have included *Nonatelia* within the circumscription of *Psychotria*, though not all. Hooker (1873: 125) considered *Nonatelia* to be a synonym of *Palicourea*, based on his identification of several of its component species as belonging to *Palicourea*, in particular *N. longiflora*, along with his inclusion of some species with 3- to 5-locular ovaries in *Palicourea*. Hooker considered *Nonatelia* and *Oribasia* Schreb. to be taxonomically equivalent, and in fact *Oribasia* is a superfluous name based on *Nonatelia*. *Oribasia* has been included in *Psychotria*, as *Psychotria* sect. *Oribasia* Müll. Arg., and has been incorrectly cited as an illegitimate superfluous name for *Palicourea* (Taylor, 1997a). However, Müller's section did not include the type species of *Nonatelia* and thus is nomenclaturally distinct from *Nonatelia*. *Psychotria* sect. *Oribasia* is today considered a synonym of *Palicourea* subg. *Palicourea* (Taylor, 1997a). The species that Hooker considered repre-

sentative of *Nonatelia*, *N. longiflora*, is today included in *Palicourea*. Hooker noted also that some of the species that have been included in *Nonatelia* do not agree with *Palicourea*. In the end, Hooker did not classify *Nonatelia* formally but only mentioned it in a note under his treatment of *Palicourea*.

Many of the species of the group treated in this article are found in Brazil and were previously studied by Müller (1881), who classified them in *Psychotria*. Müller did not designate type species for his infrageneric taxa of *Psychotria*, so the identities of some of these are not entirely clear. However, Müller's circumscription of the genus *Psychotria* was clear and differed from that of his contemporary authors. Müller's *Psychotria* generally corresponded to today's *Palicourea* (or *Palicourea* s.l.; i.e., *Palicourea* s. str. plus many of the species of *Psychotria* subg. *Heteropsychotria*; Taylor, 1996; Razafimandimbison et al., 2014). Müller classified the Brazilian species that are studied in this present article in two of his sections of *Psychotria*. His *Psychotria* sect. *Nonatelia* (Aubl.) Müll. Arg. included one species, *Psy. racemosa* (Aubl.) Raeusch. (Müller, 1881: 269). The other 23 species were included in Müller's *Psychotria* sect. *Eupsychotria* (Müller, 1881: 269; this name is invalid because the form starting with Eu- is not permitted for an autonymic taxon by the International Code of Nomenclature). Müller's *Psychotria* sect. *Eupsychotria* included a large group of species that corresponds generally to *Psychotria* subg. *Heteropsychotria* of Steyermark (1972). Within Müller's section, the species studied in this present article were classified in two series, *Psychotria* ser. *Spicatae* Müll. Arg. and *Psychotria* ser. *Stenothyrsae* Müll. Arg. (Müller, 1881: 270, as "Stenothyrsae"; 291, as "Stenostachyae"). Müller's *Psychotria* ser. *Spicatae* included four species, was diagnosed only by spiciform inflorescences, and was heterogeneous. Three of its species are included in the new section studied here, *Psy. obconica* Müll. Arg., *Psy. malaneoides* Müll. Arg., and *Psy. forsteronioides* Müll. Arg. The other species that he classified in this series, *Psy. spicata* Müll. Arg., is distinct from the others and belongs to *Palicourea* sect. *Didymocarpae* C. M. Taylor (Taylor, 2015a; the name *Psy. spicata* Müll. Arg. is an illegitimate later homonym, and this species is now called *Pal. spicata* (Kuntze) C. M. Taylor). Because the majority of the species Müller included in this group belong to the new section of *Palicourea* studied here, one of its species, *Psy. malaneoides*, is here designated as the lectotype of this series.

Müller's *Psychotria* ser. *Stenothyrsae* comprised four subseries: *Psychotria* subser. *Fissistipulae* Müll. Arg. with five species, *Psychotria* subser. *Octocuspides* Müll. Arg. with one species, *Psychotria* subser. *Quadricuspides* Müll. Arg. with 23 species, and *Psychotria* subser. *Platystipulae* Müll. Arg. with two species. All of the species of the first two subseries are classified in the new section of *Palicourea* studied in this present article, but only some of the species of Müller's *Psychotria* subser. *Quadricuspides* and none of the species of *Psychotria* subser. *Platystipulae* are included in this new section of *Palicourea*. *Psychotria* subser. *Quadricuspides* comprised generally two groups of species, one group that is included here in this new section of *Palicourea* and another group that is related instead to *Psy. deflexa* DC. (Steyermark, 1972: 498). Because *Psychotria* subser. *Quadricuspides* has been subsequently cited only by Steyermark, who considered it "in large part" equivalent to his group "*Psychotria* sect. *Heteropsychotria*" (a name with its own nomenclatural problems, which will be addressed at a later date in a separate study of those species), Müller's subseries is here lectotypified on a species representative of Steyermark's concept:

Psychotria subser. *Quadricuspides* Müll. Arg., Fl. Bras. 6(5): 272, 293. 1881. TYPE: *Psychotria paniculata* (Aubl.) Raeusch. (lectotype, designated here).

Psychotria sect. *Nonatelia* and *Psychotria* ser. *Stenothyrsae* have sometimes been confused with another of Müller's infrageneric groups, *Psychotria* sect. *Oribasia* Müll. Arg. However, *Psychotria* sect. *Oribasia* is a synonym of *Palicourea* subg. *Palicourea* (Taylor, 1997a), and Müller's other infrageneric taxa mostly or all belong to *Palicourea* subg. *Montanae* C. M. Taylor. The confusion over the identity of *Psychotria* sect. *Oribasia* is apparently because *Psychotria* sect. *Oribasia* included some species that were formerly included in *Nonatelia*, so it has been assumed to be the same as *Nonatelia*. However, Müller circumscribed *Nonatelia* following Richard (1830), to include only *Psy. racemosa*, thus his *Psychotria* sect. *Nonatelia* is monotypic and distinct from his *Psychotria* sect. *Oribasia*.

Schumann (1891) in his review of world Rubiaceae circumscribed *Psychotria* more narrowly than Müller had, with *Palicourea* separated from it similarly to Hooker (1873). Schumann did follow Müller by including *Nonatelia* within the circumscription of *Psychotria* rather than *Palicourea* and accepted *Psychotria* sect. *Nonatelia*. In contrast, Kuntze (1891), in his contemporaneous worldwide classification of Rubiaceae, separated *Nonatelia* from the other genera of the tribe Psychotrieae based on its plurilocular ovary. Kuntze synonymized under *Nonatelia* most of the other genera of Rubiaceae with

plurilocular ovaries and fleshy fruits, such as *Lasianthus* Jack and *Psathura* Comm. ex Juss. Kuntze synonymized *Palicourea* with *Uragoga* Baill., but did separate several *Palicourea* species with a plurilocular ovary into *Nonatelia*. (The name *Uragoga* is illegitimate because it was superfluous when published; Taylor & Gereau, 2013.)

Most subsequent authors did not adopt Kuntze's generic circumscriptions and followed Schumann's classification. In particular, Standley (e.g., 1931, 1936a) included *Nonatelia* within *Psychotria*. However, Bremekamp (1934) studied the tribe Psychotrieae in northeastern South America and did recognize *Nonatelia*, along with several other small genera that he separated from *Psychotria*. Bremekamp (1934: 299–300) reviewed the species that Aublet included in *Nonatelia* and concurred with Richard's circumscription of the genus, separating *Nonatelia* based on its 5-locular ovary and including only one species, *N. racemosa*. He specifically stated here that he was following Richard's narrowed circumscription of the genus. Later Bremekamp (1963: 168–171) still considered *Nonatelia* monotypic, but noted that the related genera *Palicourea* and *Psathura* also included species with 5-locular ovaries. He thus analyzed *Nonatelia* in this context and concluded that *Palicourea*, *Psathura*, and *Nonatelia* were distinct. He continued to regard *Nonatelia* as monotypic and detailed an expanded set of characters to diagnose this genus (1963: 171): closely parallel "secondary" veins (i.e., tertiary venation in the terminology used in this present study), bilobed stipules with large linear colleters on the inside (i.e., adaxial) surfaces, flowers that are 5-merous and isostylous, 5-locular ovaries, stamens inserted near the base of the corolla tube, five stigmas, fruits with five pyrenes that have thin walls and a longitudinal furrow on the adaxial side, and nonruminate endosperm. Bremekamp here regarded his circumscription and characterization of *Nonatelia* as an emendation made by him, but it does not seem distinct from the emendation made by Richard, which he explicitly said he was following in his earlier work. All of the characters he used here to diagnose *Nonatelia* are found in various species of *Palicourea* but not in this particular combination. Isostylous or monomorphic populations are known for various distylous species of *Palicourea* (Sobrevila et al., 1983; Taylor, 1993) and *Psychotria* (Sakai & Wright, 2008), and some individual species of *Palicourea* may be completely isostylous (e.g., *Pal. alpina* (Sw.) DC., *Pal. eriantha* DC.; Taylor, 1993), even though closely related species are distylous. The insertion of the stamens near the base of the corolla that Bremekamp documented for *N. racemosa* is unusual and perhaps unique in *Palicourea*. However, this character was not observed in the flowers examined in this present study, which have the filaments inserted near or above the middle of the corolla. This species also shows some variation in the level of stamen insertion as well as stigma form and may not be fully isostylous. The morphology of the flowers of *N. racemosa* is discussed in more detail in the Morphology section, which is presented later in this article.

Three of the *Palicourea* species studied in this present work were treated by Steyermark (1972) in his broad floristic review of *Psychotria* in northeastern South America. Steyermark here included *Nonatelia* within the circumscription of *Psychotria*, and he classified these three species in two different sections of *Psychotria* subg. *Heteropsychotria*. The species he classifed were *Psy. racemosa*, which he included in *Psychotria* sect. *Nonatelia* (Steyermark, 1972: 542), and *Psy. amita* Standl. and *Psy. eggersii* Standl., which he included in his unnamed *Psychotria* sect. 4 and in its unnamed ser. B (Steyermark, 1972: 526).

The *Palicourea* species studied in this present work have been treated since then only in floristic works, where they have generally all been included in *Psychotria* (e.g., Taylor et al., 2004; Lorence et al., 2012). However, Borhidi (2011) in his floristic study of Mexican Rubiaceae transferred 26 species from *Psychotria* to *Palicourea*, based on the work of Nepokroeff et al. (1999) and Taylor et al. (2010), including two of the species studied here. The species of *Psychotria* subg. *Heteropsychotria* that apparently transfer to *Palicourea* were identified and presented in a separate section from *Psychotria* subg. *Psychotria* in the floristic treatment by Lorence et al. (2012), including several of the species studied here, but those species were not transferred to *Palicourea* there, pending more detailed study that confirmed their generic classification.

The New Group *Palicourea* sect. *Nonatelia*

The new taxonomic section described here, *Palicourea* sect. *Nonatelia* (Aubl.) C. M. Taylor, includes the single species of *Psychotria* sect. *Nonatelia*, all of the species of *Psychotria* subser. *Fissistipulae* and *Psychotria* subser. *Octocuspides*, some of the species of *Psychotria* ser. *Spicatae* and *Psychotria* subser. *Quadricuspides*, and several species that have not been included previously in any infrageneric classification of *Palicourea* or *Psychotria*. These species are grouped together here based primarily on morphological characters, with

some support for the separation of this group and the systematic significance of these characters from limited molecular sequence data (Sedio et al., 2013). The species included in *Palicourea* sect. *Nonatelia* are found widely in South America and a few also range into Mexico. These species have previously only been studied in regional floras and are grouped together here for the first time. This new section does not correspond to any of the infrageneric taxa of Taylor (1997a, 2015a, 2015b), and none of its species were previously included in *Palicourea* except for the two species that Borhidi (2011) studied. This new section is provisionally classified in *Palicourea* subg. *Palicourea* based on the limited information from molecular sequence data now available, which do not find well-supported relationships for species of this group but generally find them more closely related to species of *Palicourea* subg. *Palicourea* than to those of *Palicourea* subg. *Montanae* (Sedio et al., 2013). The morphological characterizations (Taylor, 1997a) of the subgenera of *Palicourea* no longer can be used to classify species with confidence, due to the additional morphological variation now included in both subgenera of *Palicourea* (Taylor et al., 2010; Taylor, 2015a, 2015b).

Palicourea sect. *Nonatelia* includes 26 species and is diagnosed by the combination of its distinctive leaf venation (Müller, 1881: tab. 43, fig. 1); its stipules with well-developed truncate sheaths and usually well-developed, narrowly triangular to linear, often glandular, sometimes erose or divided lobes; its terminal paniculiform to spiciform inflorescences with the bracts not involucral; its rather small flowers (within *Palicourea*) with the corollas straight to markedly gibbous and bent at the base, pubescent in the throat or tube, and abaxially smooth or more often with short to well-developed appendages or horns on the lobes; its ovary locules and stigmas two or five; its fruits that are black or purple-black when mature but usually pass through yellow, orange, and sometimes red stages before maturity; and its two or five hard-walled pyrenes that are smooth to ridged abaxially.

One species is included here provisionally and is quite unusual morphologically, *Palicourea woronovii* (Standl.) C. M. Taylor, Bruniera & Zappi of the lowland Amazon basin. This species has been classified in *Rudgea* Salisb. until recently (Taylor et al., 2015). It does have the characteristic leaf venation, stipule form, and fruit form of *Palicourea* sect. *Nonatelia*. However, it is unusual in this section, and in *Palicourea* in general, in its unbranched habit, its robust subsessile leaves, with blades 23–42 × 10.5–16 cm, its robust fimbriate stipules that clasp the stem, its production of adventitious roots from the stem that grow into the detritus accumulated in the leaf bases and stipules, and its small fruits ca. 3–5 × 3–4 mm. *Palicourea woronovii* agrees with *Palicourea* sect. *Nonatelia* in all its characters except its fruits, which are apparently spongy and white at maturity. These fruits are similar in size, texture, and color to those of *Psy. deflexa*, and *Pal. woronovii* may be better classified with that species. However, *Psy. deflexa* and its related species generally have small stipules without well-developed glands, tertiary leaf venation that is characteristically less closely set than in *Pal. woronovii* and *Palicourea* sect. *Nonatelia*, and pyrenes with broader abaxial ridges. Thus, *Pal. woronovii* would be unusual in that group also and appears to share more characters with *Palicourea* sect. *Nonatelia*.

Most species of *Palicourea* sect. *Nonatelia* have been previously included in *Psychotria* (e.g., Müller, 1881; Standley, 1936a; Steyermark, 1972; Taylor et al., 2004), even though several species besides *Pal. woronovii* have stipules with well-developed glands and could be considered to belong to *Rudgea*. *Rudgea* has been separated from *Palicourea* and *Psychotria* based on its stipules that are glandular and either have a medial group of glands on the sheath, or are marginally fimbriate with the segments bearing deciduous glands (Zappi, 2003; Taylor et al., 2015); in contrast *Palicourea* and *Psychotria* have been characterized as having stipules that are not glandular, even though glandular stipules are found on and have been explictly described for various species of these other two groups (e.g., Steyermark, 1972; Taylor, 2015b). The stipules of *Palicourea* sect. *Nonatelia* have the characteristic form for *Palicourea* (Taylor, 1997a), persistent with the leaves with having two lobes on each interpetiolar side. However, the stipules of the species of *Palicourea* sect. *Nonatelia* are unusual in their lobes that have well-developed deciduous glands at the tips, and usually also have well-developed glands or colleters borne near the margins of the sheath and sometimes also along the lobes. Additionally, some species of *Palicourea* sect. *Nonatelia* have erose to fimbriate or pectinate stipule lobes. Stipule form within *Rudgea* and *Palicourea* is now known to be more complex than previously understood (Zappi, 2003; Taylor et al., 2015), and glandular stipules are now known in at least a few species of most genera of tribe Palicoureeae, including *Palicourea* (Taylor, 2015b; Taylor et al., 2015). *Palicourea* does differ from *Rudgea* in stipule form, however; *Palicourea* has two

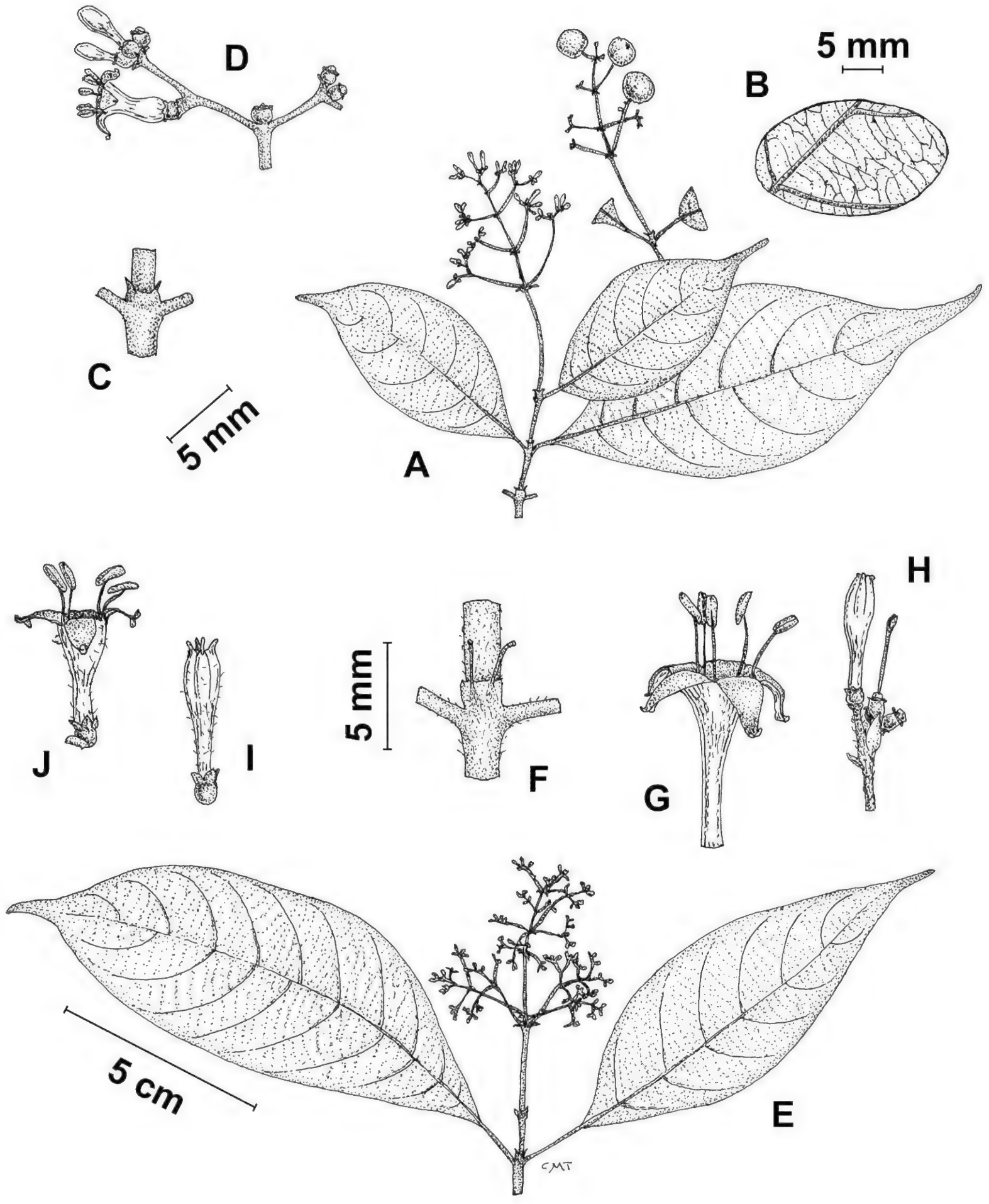

Figure 1. A–D. *Palicourea topoensis* C. M. Taylor. —A. Flowering and fruiting branches. —B. Detail of leaf venation, with portion of costa and portions of two secondary veins. —C. Portion of stem with stipule and bases of two petioles. —D. Portion of inflorescence with two flower buds and one short-styled flower at anthesis as well as four flowers from which the corollas have fallen. E–H. *Palicourea meieri* C. M. Taylor. —E. Flowering branch. —F. Portion of stem with stipule and bases of two petioles. —G. Corolla of short-styled flower at anthesis. —H. Portion of inflorescence with one flower bud and two short-styled flowers from which corollas have fallen. I–J. *Palicourea eggersii* (Standl.) C. M. Taylor. —I. Flower bud. —J. Short-styled flower at anthesis. A, E to 5-cm scale; C, D to same 5-mm scale; F–J to same 5-mm scale. A, C based on type *J. Homeier & M. A. Chinchero 1879*; B based on *S. Moritz, S. Trogisch & J. Homeier 108*; D based on *P. Butz 50*; E based on *A. Narváez, L. Cortéz & O. Kunert 273*; F based on *A. Narváez, W. Meier, C. Bohn, S. Ploeger & O. Kunert 425*; G, H based on *W. Meier, J. Matute, J. Beck & M. Kindermann 2301*; I, J based on *L. Aristeguieta 7132*.

lobes (of varied form) on each interpetiolar side, while the interpetiolar portion of the stipule is triangular to rounded or truncate in *Rudgea* (Taylor et al., 2015).

The species of *Palicourea* sect. *Nonatelia* are similar in general aspect to *Psychotria deflexa* and its related species, and these have been confused in herbarium identifications (Taylor, pers. obs.) as well as in classifications (e.g., Müller, 1881, *Psychotria* ser. *Quadricuspides*). *Psychotria deflexa* and its related species differ from *Palicourea* sect. *Nonatelia* in details of the leaf venation, their corollas with the lobes generally smooth abaxially, and their fruits that are white, blue, or purple-black at maturity and do not pass through a yellow to red immature stage. The leaf venation of *Psy. deflexa* and related species generally is rather similar in its well-developed tertiary venation to *Palicourea* sect. *Nonatelia*, but characteristically *Psy. deflexa* and related species have several developed intersecondary veins present between each pair of secondary veins in contrast to no intersecondary veins, these few and weak, or these curving and extending to unite with secondary veins in *Palicourea* sect. *Nonatelia*. *Psychotria deflexa* and related species also have tertiary veins that are extensively reticulated between each pair of secondary veins, in contrast to well-developed but with few or no reticulations in *Palicourea* sect. *Nonatelia*.

Palicourea sect. *Nonatelia* is found widely in the Neotropics in humid to very wet vegetation, from lowland to montane vegetation, in continental regions from Mexico to northern Argentina and also in Trinidad. The most widespread and commonly collected species is *Pal. racemosa* (Aubl.) Borhidi, which is found in lowland forests in almost the full range of this group. *Palicourea* sect. *Nonatelia* has centers of diversity in the Andes and the Atlantic forest of eastern Brazil. *Palicourea* sect. *Nonatelia* has some rather notable variation in stipule form, inflorescence arrangement, corolla shape, fruit size, number of ovary locules, biogeography, and elevational range, but no group of species can be separated by a distinctive feature or consistent set of features; therefore, no species groups are separated here formally or informally.

Morphological Notes on *Palicourea* sect. *Nonatelia*

The features that specifically diagnose and characterize this group are outlined in the previous section of this article. Some generalizations, details, and unusual features are noted now in this section.

In *Palicourea* sect. *Nonatelia* the leaf venation is characteristically well developed, at least on the abaxial leaf surface, and distinctive in arrangement. The secondary veins are eucamptodromous to brochidodromous, and prominent abaxially but generally plane to impresssed adaxially. Intersecondary veins are usually lacking or may be present but few and weakly developed; occasionally these are well developed and then they curve without reticulating to connect to secondary veins. Domatia appear to be absent, except in several species a line of ciliate pubescence along each side of the midrib is found on the lower surface of the leaf and may serve this function. The tertiary veins are characteristically well developed and are thinly prominulous abaxially and often also adaxially. The tertiary veins are typically closely subparallel, and extend between and connect on both ends to the adjacent secondary veins or sometimes are closely reticulated in the area between a pair of secondary veins. This tertiary venation generally forms elongated areoles within which the higher-order venation is reticulated though not usually readily visible (e.g., Fig. 1B; Müller, 1881: tab. 43 fig. 1, tab. 45, tab. 46, tab. 47 fig. 1). The combination of the subparallel, well-developed tertiary venation and the lack of intersecondary veins that parallel the secondary veins is unusual within *Palicourea*. *Psychotria deflexa* and its related species have superficially similar venation, but those species differ in several details as outlined above in characterization of this new taxonomic group, presented in the immediately previous section of this article.

The stipules in *Palicourea* sect. *Nonatelia* vary in the development of their glands, from few to numerous, but glands are consistently borne on the adaxial surfaces of the lobes and the upper part of the sheath, except in *Pal. locellata* C. M. Taylor. The glands found in the species of this group are relatively large for *Palicourea*, usually ca. 1 mm or more long, and may be deciduous, or frequently they persist and become indurate. In several species the stipule lobes are entire but appear to be lobed or fimbriate due to the glands that are inserted on or near the margins (Fig. 2B). However, in some species the stipule lobes actually are marginally lobed or fimbriate or pectinate (e.g., *Pal. octocuspis* (Müll. Arg.) C. M. Taylor), with the lobes or segments glandular at their tips. The stipules of *Pal. locellata* are unusual within this group and also within *Palicourea*. These are fused to form a well-developed, rather slender tube with a narrow, apparently truncate top that bears exceptionally well-developed glands that are arranged in two groups (Fig. 3B). The stipules of this species split longitudinally as the stems enlarge, forming an apparently spathaceous structure, and the glands are persistent (Fig. 3C). These glands are borne at the top of the sheath, or perhaps

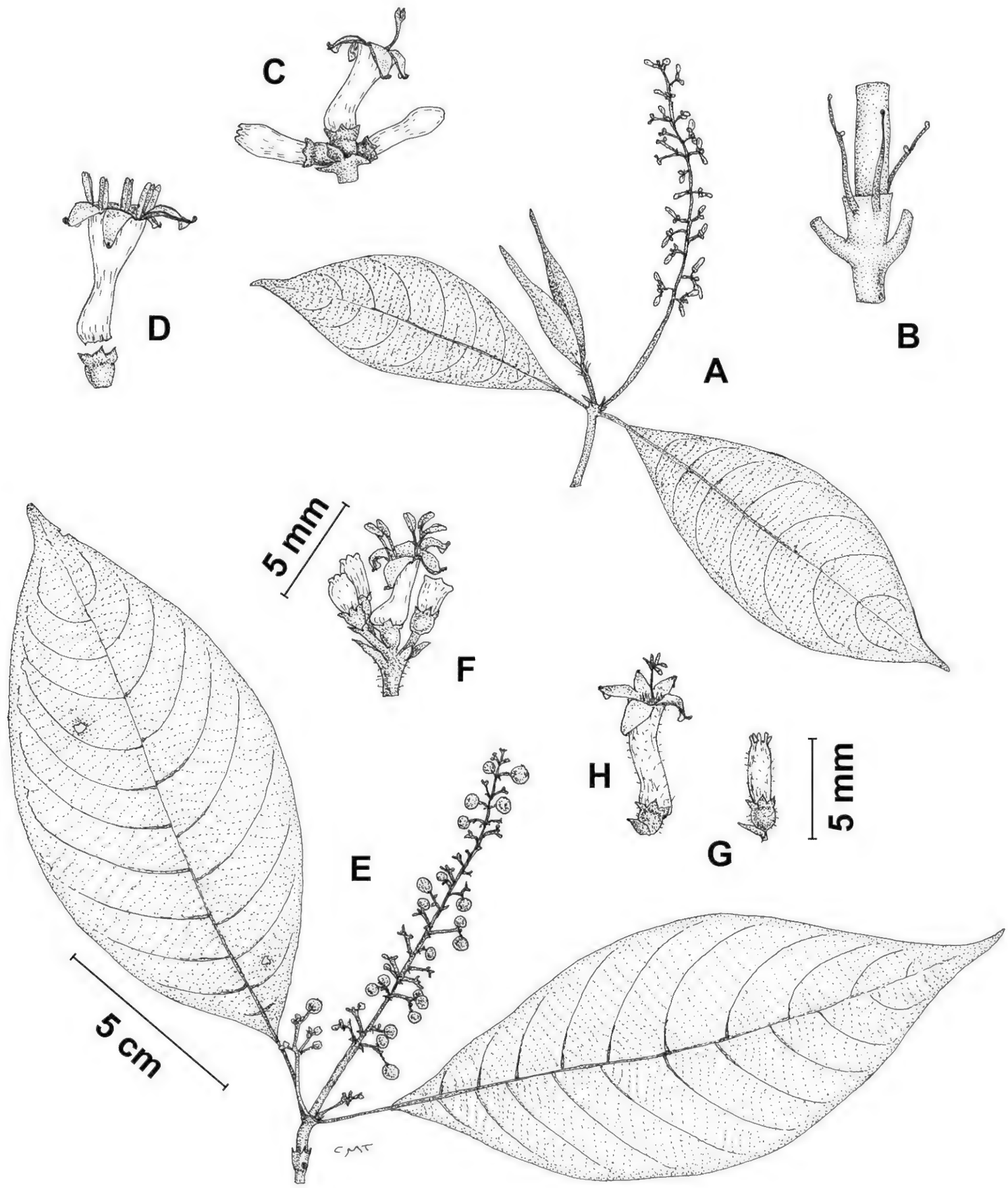

Figure 2. A–D. *Palicourea cajamarcana* C. M. Taylor. —A. Flowering branch. —B. Portion of stem with stipule and bases of two petioles. —C. Portion of inflorescence with two flower buds and one long-styled flower at anthesis. —D. Flower at anthesis, partially dissected. E, F. *Palicourea dodsoniana* C. M. Taylor. —E. Fruiting branch. —F. Portion of inflorescence with three flower buds and one short-styled flower at anthesis. G, H. *Palicourea stenostachya* (Standl.) C. M. Taylor. —G. Flower bud with subtending bract. —H. Long-styled flower at anthesis, with subtending bract. A, E to 5-cm scale; B–D, F to same 5-mm scale; G, H to same 5-mm scale. A, C based on *A. Sagástegui A., E. García & S. Leiva 12406*; B based on *J. Campos, P. Díaz & W. Alorcán 2937*; D based on *A. Monteagudo, J. L. Mateo & R. Francis 12447*; E based on *L. P. Kvist 40066*; F based on *C. Persson, C. Gustafsson, B. B. Klitgaard & E. Wilson 63*; G, H based on *D. Neill & S. Manning 8017*.

adaxially just below the margin with the margin shortly revolute.

The inflorescences are terminal in *Palicourea* sect. *Nonatelia* and only infrequently displaced to pseudoaxillary. The inflorescences are basically thyrsiform and branched in arrangement, but in several species the axes are reduced so the flowers are borne in one to several congested to subcapitate groups. *Palicourea*

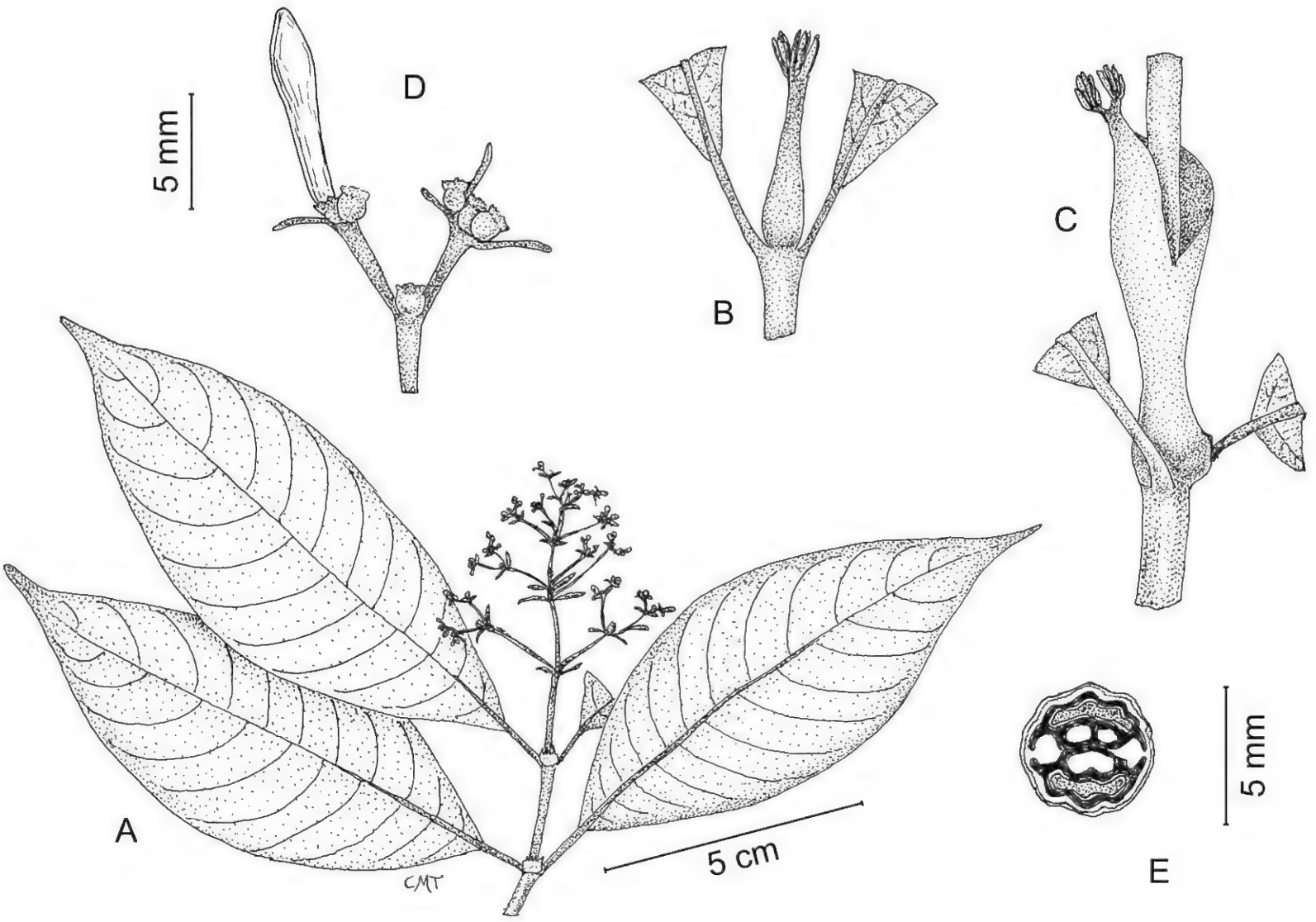

Figure 3. *Palicourea locellata* C. M. Taylor. —A. Flowering branch. —B. Stem apex with stipule and basal portions of two leaves. —C. Portion of stem with stipule and basal portions of two leaves. —D. Portion of inflorescence, with one flower bud and five flowers from which corollas have fallen. —E. Cross-section of dried fruit, with fruit wall and two pyrenes; stippled section of pyrenes indicates seed tissue. B–E to same 5-mm scale. A, D based on *J. Fernández, L.-C. Cárdenas, D. Vera & V. Paez 16379*; B based on *J. Fernández, L.-C. Cárdenas, D. Vera & V. Paez 16437*; C, E based on *R. López C., Y. Marínez, N. Cruz, M. A. Pinzón & R. Pinzón 4145*.

sect. *Nonatelia* has no species with subcapitate or capitate inflorescences enclosed by involucral bracts, and most of its species generally lack bracts that are large enough to equal or exceed the flower buds; bracts this large are found in *Pal. carnosocarpa* (Dwyer & M. V. Hayden) C. M. Taylor, *Pal. locellata*, and *Pal. soejartoi* (C. M. Taylor) C. M. Taylor. In several species of *Palicourea* sect. *Nonatelia* the inflorescences are racemiform, with the primary axis well developed and the secondary axes reduced so that the flower groups are borne apparently directly on the primary axis (e.g., *Pal. malaneoides* (Müll. Arg.) C. M. Taylor). In most of the species of this new section the inflorescence axes elongate as the fruits mature, so the infructescence becomes larger and laxer than the inflorescences. The inflorescence axes and bracts are generally green or pale green at anthesis, and the infructescence axes may not become purple as in most *Palicourea* species, but information on infructescence color is limited.

The flowers in the species of *Palicourea* sect. *Nonatelia* that are adequately documented are distylous, except for *Pal. racemosa*, which appears to be isostylous as noted by Bremekamp (1934). However, the floral biology, whether the flowers are distylous or not, has not been confirmed for some of the species of this group. In all of the species of *Palicourea* sect. *Nonatelia*, the anthers and stigmas are either fully exserted, or are positioned in the middle or upper part of the corolla tube and in this case usually partially exserted. The flowers of *Pal. racemosa* have not been documented well at anthesis but do appear to consistently have the anthers partially exserted and the stigmas positioned just at or above the tops of the anthers. However, the stamens on the flowers studied (e.g., *C. Knab-Vispo 216*, *T. Croat 15116*, *X. Cornejo 7513*, *M. Nee 37340*, all MO) have their filaments consistently inserted near or above the middle of the corolla tube, not at the base. Also there appears to be some variation in this species in the form of the stigmas or perhaps the top portion of the style, with the degree of lobing ranging from short to deep, but this character is difficult to evaluate on herbarium specimens. Thus *Pal. racemosa* does possibly appear to be isostylous;

however, if this variation in stamen insertion and stigma form is not an artifact of comparing flowers at different stages of development, there may actually be two flower forms in this species. Field observations will certainly be needed to understand the floral biology of this species.

The flowers in *Palicourea* sect. *Nonatelia* are generally relatively small for *Palicourea*, with the corollas at most 10 mm long; the largest flowers in this group are found in *Pal. cajamarcana* C. M. Taylor and *Pal. meieri* C. M. Taylor, with corolla tubes up to 6 mm long, and the shortest are those of *Pal. mamillaris* (Müll. Arg.) C. M. Taylor from eastern Brazil, with corolla tubes 0.8–1 mm long. The calyx and corolla are generally 5-lobed but are 4-lobed in *Pal. eggersii* (Standl.) C. M. Taylor and *Pal. locellata*, and the stamens are equal in number to the corolla lobes. The corollas are tubular to funnelform, and at the base are straight to more often bent and swollen, symmetrically to quite asymmetrically. The corollas that are bent at the base sometimes have a corresponding curve in the tube that places the top of the corolla tube directly over the base. The corollas that have been fully described are white to cream or pale yellow, glabrous to variously pubescent outside, and internally densely pubescent in the throat and usually also in the upper part of the tube. The corolla lobes are usually appendaged at the apex, with a short adaxial flap that is enclosed in the bud, and are often thickened or apparently shortly galeate here (Fig. 1J). Abaxially the corolla lobes are variously smooth to medially thickened or appendaged. The abaxial corolla lobe appendages vary from a rounded to conical thickening ca. 0.2 mm long, to a linear horn up to 1 mm long (i.e., Müller, 1881: tab. 44, fig. 1). On dried specimens these abaxial appendages of the corolla lobes appear in many species to have their maximum size on the maturing buds, and then to become smaller at anthesis; field observations are needed to confirm this. The specific function of these corolla lobe appendages is not known, though presumably they give a distinctive aspect to the flowers and play a part in pollinator attraction. The ovary locules, stigmas, lobes of the disk, and pyrenes are two in most species of *Palicourea*, but there are five locules, stigmas, disk lobes, and pyrenes in several species of *Palicourea* sect. *Nonatelia*.

The fruits in *Palicourea* sect. *Nonatelia* are apparently all black or purple-black when mature, except *Pal. woronovii* apparently has white fruits. The final, mature color is usually not observed, however. The fruits apparently develop their final color quickly when the fruit reaches maturity, and only a few fruits mature at a time and these disappear rapidly from the plants. Presumably the mature fruits are rapidly removed by frugivores. The fruits of *Pal. woronovii* are spongy (Taylor et al., 2015), while those of *Pal. racemosa* and *Pal. stenostachya* (Standl.) C. M. Taylor are juicy (C. M. Taylor, pers. obs.); however, the fruit texture of the other species in this group is not specifically known. The fully developed fruits variously have two or five pyrenes. When the pyrenes are two, they are hemispherical to subglobose in general shape; when the pyrenes are five they are wedge-shaped. The pyrenes are hard-walled and variously smooth to longitudinally angled or ridged on the abaxial (i.e., dorsal) surface. The pyrenes of *Pal. locellata* are unusual in this group and in *Palicourea* in having one or two separate, apparently empty chambers or partially enclosed spaces (Fig. 3C). This pyrene form is not unique in this tribe, however; for example, a similar form is found in some species of *Carapichea* (Taylor & Gereau, 2013).

Methods

This work is based on standard herbarium techniques. Additional information and tools, including detailed specimen data with distribution, elevation, and phenology charts, high-resolution scans of representative specimens of most of these species, and additional comments on their circumscription and recognition, are available online in the TROPICOS® database and its Rubiaceae Project. The species treated here are arranged in alphabetical order. Types were studied variously as physical specimens, as photographs, as high-resolution scans in JSTOR Global Plants (<http://plants.jstor.org>), and as photographs provided directly by some herbaria. Morphological terminology follows that of Lawrence (1951) and Taylor (1997a). Morphological measurements are based on dried specimens; for this reason, fruit measurements here mainly measure pyrene size. Comparative description of size of morphological structures refers to the group of species studied here. Habitat and distribution are summarized for all the taxa treated here, but phenology is only summarized for taxa newly described because only those have been comprehensively detailed. Elevational distributions for the species are given in meters above sea level. Conservation assessments here follow IUCN (2001) terminology; however, the new taxa described here are found in areas with active Red Listing projects and regional plant conservation specialist groups, so detailed provisional conservation assessments are not presented here but left for these better-informed teams to analyze. This article presents a taxonomy of a group not previously studied as preparation for the

World Flora Online. The names *Psychotria* and *Palicourea* are nomenclaturally distinct but similar and commonly confused, therefore the non-standard abbreviations *Psy.* and *Pal.*, respectively, are used in the text here for clarification.

Taxonomic Treatment

Palicourea sect. **Nonatelia** (Aubl.) C. M. Taylor, comb. nov. *Nonatelia* Aubl., Hist. Pl. Guian. 1: 182, tab. 70–85. 1775; emend A. Rich., Mem. Soc. Hist. Nat. Paris 5: 206. 1830, excl. spp. *Oribasia* Schreb., Gen. Pl. 123. 1789, nom. superfl. illeg. *Psychotria* sect. *Nonatelia* (Aubl.) Müll. Arg., Fl. Bras. 6(5): 222, 269. 1881. *Nonatelia* sect. *Oribasia* (Schreb.) Kuntze, Revis. Gen. Pl. 1: 291. 1891, nom. superfl. TYPE: *Nonatelia racemosa* Aubl. (lectotype, designated by Richard [1830: 207]).

Psychotria ser. *Stenothyrsae* Müll. Arg., Fl. Bras. 6(5): 271, 289. 1881; *Psychotria* ser. *Stenostachyae*, orth. var. TYPE: *Psychotria stellaris* Müll. Arg. (lectotype, designated here).

Psychotria subser. *Fissistipulae* Müll. Arg., Fl. Bras. 6(5): 271, 290. 1881. TYPE: *Psychotria fissistipula* Müll. Arg. (lectotype, designated here).

Psychotria subser. *Octocuspides* Müll. Arg., Fl. Bras. 6(5): 272, 292. 1881. TYPE: *Psychotria octocuspis* Müll. Arg. (lectotype, designated here).

Psychotria ser. *Spicatae* Müll. Arg., Fl. Bras. 6(5): 273, 306. 1881. TYPE: *Psychotria malaneoides* Müll. Arg. (lectotype, designated here).

Psychotria ser. *Stachythyrsae* K. Schum., Nat. Pflanzenfam. 4(4): 113. 1891. TYPE: *Psychotria forsteronioides* Müll. Arg. (lectotype, designated here).

Shrubs and small trees, glabrous to occasionally villosulous, puberulous, or pilosulous, sometimes sparingly branched and with adventitious roots growing into detritus accumulated inside stipules (*Palicourea woronovii*); stems quadrate to somewhat flattened or occasionally terete (*Pal. locellata*), internodes smooth. Leaves opposite, decussate; blades generally elliptic to elliptic-oblong, obovate, or oblanceolate, matte or sometimes shiny; secondary veins developed, with intersecondary veins absent, few, or occasionally 1 to 3 intersecondary veins regularly developed between each pair of secondary veins and these extending to unite with secondary veins, with tertiary venation well developed and usually subparallel, with venation generally plane adaxially and prominulous to prominent abaxially, without domatia; margins generally plane; petioles short to well developed; stipules persistent or sometimes deciduous below distalmost 2 to 3 nodes via fragmentation, united around stem into a continuous sheath, this short to well developed or occasionally prolonged into a tube (*Pal. locellata*) or reduced in the intrapetiolar portions (*Pal. woronovii*), with 2 lobes on each interpetiolar side or these reduced (*Pal. locellata*), the lobes narrowly triangular to linear or rarely ligulate to elliptic (*Pal. woronovii*), separated or occasionally fused into a single lobe (*Pal. valerioana* (Standl.) C. M. Taylor), variously inserted on margin of sheath or abaxially below margin of sheath or medially, entire to erose or glandular, simple to bifid or multifid, adaxially with well-developed glands ca. 1 mm on sheath and/or lobes, these glands sometimes persistent and becoming indurate. Inflorescences terminal and only infrequently becoming displaced to pseudoaxillary as fruits mature, pedunculate with peduncle sometimes well developed, subcapitate to branched up to 4 orders, corymbiform to paniculiform, racemiform, or spiciform, with secondary axes generally paired, bracteate or bracts reduced, with flowers arranged in glomerules or dichasial cymes that are borne at ends of principal axes. Flowers sessile or sometimes pedicellate, at least sometimes distylous or infrequently apparently isostylous (*Pal. racemosa*); hypanthium (i.e., ovary portion of flower) generally ellipsoid; calyx limb generally rather short, undulate to 4- or 5-lobed; corolla tubular to salverform, white to yellow, internally pubescent in throat and/or sometimes in middle to upper part of tube, with tube rather small (0.8–7 mm long), straight to markedly bent and/or gibbous at base, with corolla lobes 5 or infrequently 4 (*Pal. eggersii*, *Pal. locellata*), triangular, generally equal to or shorter than corolla tube, abaxially smooth to medially thickened or with short to well-developed appendage, at apex usually with short geniculate appendage; stamens 5 or infrequently 4, inserted near or above middle of corolla tube, anthers narrowly ellipsoid-oblong, included to partially exserted in long-styled and isostylous forms, exserted in short-styled form; stigmas 2 or 5, linear to subcapitate, included and positioned near or above middle of corolla tube in short-styled form, exserted in long-styled and isostylous forms; disk 2- or 5-lobed, generally equal to or shorter than calyx limb. Infructescences similar to inflorescences or sometimes axes elongating, perhaps sometimes becoming purple. Fruits subglobose to ellipsoid, weakly didymous, or infrequently obovoid and truncate at top (*Pal. obconica* (Müll. Arg.) C. M. Taylor), rather small to somewhat large (3.5–6 × 3.5–8 mm), becoming white, yellow, orange, or red and then usually purple-black or dark violet; pyrenes 2 and planoconvex or 5 and wedge-shaped, abaxially (i.e., dorsally) smooth to 4- or 5-angled or -ridged, adaxially (i.e., ventrally) flat to weakly

concave and with a longitudinal sulcus and sometimes a basal pore, rarely with marginal flanges and adaxial chambers (*Pal. locellata*).

Size, distribution, and habitat. *Palicourea* sect. *Nonatelia* comprises 26 species found in humid to wet forests at 0–2500 m from southern Mexico through Central America into southern tropical South America, in South America along the Andes south to Bolivia and eastward to the Guianas, eastern Brazil, Paraguay, and northern Argentina.

KEY TO THE SPECIES OF *PALICOUREA* SECT. *NONATELIA*

1. Leaf blades 23–43 cm long, with 18 to 22 pairs of secondary veins; stipule lobes 20–30 mm long, fimbriate to multifid; stems sometimes with adventitious roots growing inside the stipules and the clasping leaf bases . . . . . 26. *Pal. woronovii* (Standl.) C. M. Taylor, Bruniera & Zappi
1′. Leaf blades 3–24 cm long, with 5 to 14 pairs of secondary veins; stipule lobes lacking or 0.5–18 mm long and entire to bifid or fimbriate; stems without adventitious roots.
2. Stipules with sheath (fused) portion tubular, 9–18 mm long and subtruncate with 2 groups of glands, the sheath splitting to form an apparently spathaceous structure as stem enlarges; pyrenes with marginal flanges and adaxially with 1 or 2 partially to fully enclosed chambers . . . . . 10. *Pal. locellata* C. M. Taylor
2′. Stipules with sheath portion 0.5–8 mm long, with 4 triangular lobes 0.5–12 mm long, with sheath not or only shortly splitting with age, not becoming spathaceous; pyrenes without marginal flanges and adaxially plane and without chambers.
3. Stipule lobes 1 on each interpetiolar side, inserted centrally (medially) on sheath, entire or usually bifid at apex . . . . . 24. *Pal. valerioana* (Standl.) C. M. Taylor
3′. Stipule lobes 2 on each interpetiolar side, inserted at sheath margin, just below sheath margin, or medially on sheath, the lobes entire to bifid or multifid.
4. Inflorescence shortly corymbiform to subcapitate, with primary axis shorter than or equal to secondary axes . . . . . 25. *Pal. veracruzensis* (Lorence & Dwyer) Borhidi
4′. Inflorescences paniculiform or racemiform or spiciform, with primary axis well developed and longer than secondary axes (when these are developed).
5. Stigmas, ovary locules, lobes of disk, and pyrenes 5, the pyrenes wedge-shaped; corolla lobes with abaxial appendages or horns 0.2–1.2 mm long.
6. Inflorescences with branched portion pyramidal to broadly pyramidal in outline; corolla tube 1.5–3 mm long; plants drying grayish green to green; plants of Mexico to southeastern Brazil . . . . . 17. *Pal. racemosa* (Aubl.) Borhidi
6′. Inflorescences with branched portion narrowly pyramidal in outline to cylindrical, racemiform, or spiciform; corolla tube 2.5–5 mm long; plants drying grayish green, blackened, yellowish brown, or orangish brown; plants of southern Central America, western Ecuador, and the eastern slopes of the northern and central Andes through the Amazon and Orinoco basins.
7. Inflorescence with branched portion 3–3.5 cm long; corolla lobes with abaxial appendages 0.5–1.2 mm long; plants of southern Central America . . . . . 23. *Pal. tsakiana* (C. M. Taylor) C. M. Taylor
7′. Inflorescence with branched portion 3–12.5 cm long; corolla lobes with abaxial appendages 0.2–1 mm long; plants of western Ecuador and the eastern Andean foothills of the northern and central Andes through the Amazon and Orinoco basins.
8. Corolla with tube ca. 3.5 mm long and swollen and bent at ca. 90° at base; fruit 3–5 × 5–6 mm; plants of western Ecuador . . . . . 6. *Pal. dodsoniana* C. M. Taylor
8′. Corolla with tube 2.5–7 mm long, at base straight to swollen and bent up to ca. 45°; fruits 5–6 × 6–7 mm; plants of the eastern foothills of the northern and Central Andes and Amazon and Orinoco basins.
9. Stems densely strigillose to velutinous; inflorescences with flowers borne in sessile to subsessile glomerules that are borne directly from the primary axis or on secondary axes up to ca. 5 mm long; corolla tube 4.5–7 mm long, at base bent for up to 45° and gibbous; pyrenes abaxially with well-developed rounded to acute ridges; plants drying green or orangish brown . . . . . 19. *Pal. stenostachya* (Standl.) C. M. Taylor
9′. Stems glabrous to hirtellous; inflorescences with flowers borne in glomerules or dichasial cymes that are borne on secondary axes 2–20 mm long; corolla tube 2.5–6 mm long, at base straight or swollen and bent to ca. 30°; pyrenes abaxially smooth or with weak to developed rounded ridges; plants drying green or blackish to grayish green or brown . . . . . 20. *Pal. subfusca* (Müll. Arg.) C. M. Taylor

5′. Stigmas, ovary locules, lobes of disk, and pyrenes 2, the pyrenes planoconvex or hemispherical; corolla lobes abaxially smooth, thickened, or with appendages or horns to 0.8 mm long.
10. Inflorescences spiciform with flowers sessile and subsessile in glomerules, these glomerules mostly or all borne directly on the primary axis and sessile or subsessile.
11. Corolla tube 4–5 mm long; bracts 2–6 mm long; plants of Colombia. . . . . 18. *Pal. soejartoi* (C. M. Taylor) C. M. Taylor
11′. Corolla tube 1.5–2.5 mm long; bracts 0.3–4 mm long; plants of southeastern Brazil.
12. Bracts subtending flowers 0.5–5 mm long; calyx lobes narrowly triangular, 0.5–2 mm long and unequal on an individual flower, densely hirtellous; corolla tube 1–1.5 mm long . . . 9. *Pal. forsteronioides* (Müll. Arg.) C. M. Taylor
12′. Bracts subtending flowers 0.5–2 mm long; calyx lobes deltate, 0.5–1 mm long and generally equal on an individual flower, glabrous to strigillose or sparsely hirtellous; corolla tube 2–2.5 mm long . . . . . 11. *Pal. malaneoides* (Müll. Arg.) C. M. Taylor
10′. Inflorescences paniculiform to racemiform, with flowers sessile to pedicellate in glomerules or cymes, these glomerules or cymes borne on short to well-developed secondary axes.
13. Fruits markedly obovoid, widest at top and truncate there. . . . . 15. *Pal. obconica* (Müll. Arg.) C. M. Taylor
13′. Fruits ellipsoid to subglobose or weakly didymous, thus obtuse to rounded or emarginate at top.
14. Corolla tube 3.5–7 mm long; plants of the mountains of northern Venezuela and Andean Ecuador and Peru.
15. Corolla lobes 1.5–2 mm long; fruits 5–6 × 6–8 mm, with pyrenes abaxially smooth to broadly angled or broadly ridged; plants of Andean Ecuador and Peru.
16. Corolla with tube 4.5–6 mm long and lobes abaxially with medial appendage ca. 0.3 mm long; pyrenes abaxially sometimes smooth when young, but angled to ridged at maturity; plants of Peru . . . . . 4. *Pal. cajamarcana* C. M. Taylor
16′. Corolla with tube ca. 3.5 mm long and lobes abaxially smooth or a little thickened; pyrenes abaxially smooth; plants of Ecuador . . . . . 22. *Pal. topoensis* C. M. Taylor
15′. Corolla lobes 2.7–3.2 mm long; fruits 3–4 × 4–5 mm, with pyrenes abaxially with narrow longitudinal ridges; plants of the mountains of northern Venezuela.
17. Stipule lobes 0.5–0.8 mm long; flowers sessile in glomerules, with 4 to 5 calyx lobes, corolla lobes, and stamens; calyx limb 0.5–0.7 mm long; leaves 4–11 × 1–3.5 cm . . . 7. *Pal. eggersii* (Standl.) C. M. Taylor
17′. Stipule lobes 1–2.2 mm long; flowers borne in dichasial cymes, sessile but separated on developed inflorescence axes, with 5 calyx lobes, corolla lobes, and stamens; calyx limb 0.1–0.3 mm long; leaves 4.5–16 × 1.7–6 cm . . . . . 13. *Pal. meieri* C. M. Taylor
14′. Corolla tube 0.8–3 mm long (corollas unknown in *Pal. tacarcunensis* (Dwyer) C. M. Taylor); plants of Mexico and Central America, the northern Andean Cordillera, and lowland South America through the Guianas, eastern Brazil, and Paraguay.
18. Stipule lobes bifid to multifid or occasionally a few subentire; corolla tube 2–3 mm long.
19. Leaves rounded to truncate at base; plants of Mexico and Central America . . . . . 25. *Pal. veracruzensis* (Lorence & Dwyer) Borhidi
19′. Leaves obtuse to acute at base; plants of eastern Brazil.
20. Calyx limbs 0.8–1 mm long, with lobes narrowly triangular and equal or sometimes unequal on an individual flower; corolla lobes abaxially smooth to thickened . . . . . 8. *Pal. fissistipula* (Müll. Arg.) C. M. Taylor
20′. Calyx limbs 0.3–0.5 mm long, with lobes deltate and generally equal on an individual flower; corolla lobes abaxially with appendages 0.2–0.5 mm long . . . . . 16. *Pal. octocuspis* (Müll. Arg.) C. M. Taylor
18′. Stipule lobes simple or sometimes some of them bifid; corolla tube 0.8–3.8 mm long.
21. Flowers subtended by bracts 2–5 mm long. . . . . 5. *Pal. carnosocarpa* (Dwyer & M. V. Hayden) C. M. Taylor
21′. Flowers subtended by bracts 0.1–1 mm long.

22. Calyx limbs 0.5–1 mm long; corolla lobes 1.5–2 mm long; inflorescences with basalmost pair of secondary axes not or only a little longer than the next (distal) several pairs of secondary axes; leaf blades 4–15 cm long.
    23. Stipule lobes 3–5 mm long; plants drying green or grayish green; Minas Gerais, Brazil, to northern Argentina at elevations of 150–750 m . . . . . 3. *Pal. brevicollis* (Müll. Arg.) C. M. Taylor
    23′. Stipule lobes 0.7–3 mm long; plants drying brownish green to reddish brown; northern Andes and southern Central America at elevations of 1500–2800 m.
        24. Calyx limbs 0.5–0.7 mm long; plants of the Andes . . . . . 1. *Pal. amita* (Standl.) C. M. Taylor
        24′. Calyx limbs 0.8–1 mm long; plants of Cerro Tacarcuna on the Panama–Colombia border . . . . . 21. *Pal. tacarcunensis* (Dwyer & M. V. Hayden) C. M. Taylor

22′. Calyx limbs 0.1–0.3 mm long; corolla lobes ca. 1 mm long; inflorescences with basalmost pair of secondary axes not or only a little longer than the next (distal) several pairs of secondary axes, or sometimes with basalmost secondary axes markedly longer, up to twice as long; leaf blades 7.5–20 cm long.
    25. Leaf blades at apex long-acuminate; corolla lobes with abaxial appendages 0.3–0.5 mm long; Brazil, in Rio de Janeiro State . . . 2. *Pal. apiculata* (Müll. Arg.) C. M. Taylor
    25′. Leaf blades at apex acute to shortly acuminate; corolla lobes abaxially smooth or with abaxial thickenings to 0.3 mm long; Brazil, in Bahia to Minas Gerais and Espírito Santo States.
        26. Leaf blades elliptic to elliptic-oblong or obovate, 3.5–8.5 cm wide; inflorescences with branched portion 4.5–10 × 2–8 cm, with basalmost pair of secondary axes markedly longer than the next (distal) several pairs of secondary axes; bracts 0.5–1 mm long; corolla tube 0.8–1 mm long; fruits 3.5–4 × 4.5 mm; Brazil, in Minas Gerais and São Paulo to Bahia and Espírito Santo States . . . . . 12. *Pal. mamillaris* (Müll. Arg.) C. M. Taylor
        26′. Leaf blades oblanceolate, 2.5–5 cm wide; inflorescences with branched portion 3–4.5 × 1.5–3.5 cm, with basalmost pair of secondary axes not or only a little longer than the next several pairs of secondary axes; bracts reduced or up to 0.5 mm long; corolla tube 1.2–1.5 mm long; fruits ca. 4.5 × 6 mm long; Brazil, in Bahia State . . . . . 14. *Pal. minutiflora* (Müll. Arg.) C. M. Taylor

1. Palicourea amita (Standl.) C. M. Taylor, comb. nov. Basionym: *Psychotria amita* Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 7(1): 85. 1930. TYPE: Colombia. Santander: Eastern Cordillera, vic. California, 2000 m, 11–27 Jan. 1927, *E. P. Killip & A. C. Smith 17080* (holotype, US-1325729 n.v., US-1325729 as image; isotype, NY [barcode] 00132590 n.v., NY [bc] 00132590 as image).

Psychotria canaguensis Standl. & Steyerm., Fieldiana, Bot. 28: 597. 1953. *Psychotria amita* fo. *canaguensis* (Standl. & Steyerm.) Steyerm., Mem. New York Bot. Gard. 23: 528. 1972. TYPE: Venezuela. Mérida: SW Canaguá, Quebrada de Los Salichales, tributary Río Canaguá, 1950–2135 m, 9 May 1944, *J. A. Steyermark 56441* (holotype, F-11893517 n.v., F-11893517 as image; isotypes, NY [barcode] NY00002836 n.v., NY [bc] NY00002836 as image, US-2368022 n.v., US-2368022 as image).

Habitat and distribution. This species is known from wet forest in the Andes of Venezuela and eastern Colombia, at elevations of (650–)1500–2500 m.

Discussion. *Palicourea amita* is characterized by its rather small leaves; its flowers that are sessile to shortly pedicellate and borne in lax groups; its short corollas (tubes 2–3.8 mm long) with the lobes smooth

abaxially; and its weakly didymous fruits. A description and illustration of this species were presented by Steyermark (1974: 1331–1335, fig. 209; as *Psychotria amita*). *Palicourea amita* is similar to *Pal. eggersii*, and these have been confused by various authors (e.g., Steyermark, 1972: 528); *Pal. eggersii* can be recognized by its flowers that are sessile in small glomerules or groups and usually 4-merous, along with its longer corollas (tubes ca. 5 mm long) with well-developed abaxial appendages on the lobes. In part due to this confusion *Pal. amita* was described a second time, as *Psy. canaguensis* Standl. & Steyerm. Another part of the taxonomic confusion here was due to the presence of a third, previously undescribed species that has similarities to both of these. This third species is described in this present article as *Pal. meieri* C. M. Taylor, and has corollas similar in size to those of *Pal. eggersii* but 5-merous and a calyx limb much shorter than that of either of the previously described species.

Steyermark (1972) separated two forms of *Psychotria amita* based on the pubescence of the stems, petioles, and stipules. He separated *Psy. amita* fo. *amita* by having these structures glabrous to puberulous, versus densely hirtellous to strigillose-hirtellous in *Psy. amita* fo. *canaguensis*. However, Steyermark noted (1972: 528) in the protologue of *Psy. amita* fo. *canaguensis* that several plants of this species had an intermediate pubescence form, including some of the paratypes of *Psy. amita*, and apparently did not classify these to form. There is no evident geographic pattern of pubescence variation in *Psy. amita*, nor any correlation of pubescence with any other morphological feature. For example, specimens from a single locality, the Parque Nacional Guaramacal in Venezuela, vary from entirely glabrous (*N. Cuello et al. 2217*, MO; *B. Stergios et al. 19354*, MO); to strigillose-puberulous on the stems and strigillose-hirtellous on the petioles and the lower portion of the stipule sheath but glabrous on the upper portion of the sheath (with pubescence variously sparse, *B. Stergios et al. 20891*, MO, or dense, *L. Dorr et al. 8190*, MO); to densely pilosulous-puberulous on all of these structures (*B. Stergios 20888*, MO). Because no other differences are evident among the plants that vary in pubescence and the variation is continuous, these forms are not recognized here.

2. Palicourea apiculata (Müll. Arg.) C. M. Taylor, comb. nov. Basionym: *Psychotria apiculata* Müll. Arg., Flora 59: 549, 552. 1876. *Uragoga apiculata* (Müll. Arg.) Kuntze, Revis. Gen. Pl. 2: 959. 1891. TYPE: Brazil. Rio de Janeiro: Mandioca, Dec. 1822, *L. Riedel 360 p.p.* (holotype, G [barcode] G00300275, G [bc] G00300275 as image, G [bc] G00300275 as photo F neg. 25763 at MO-1695135; isotypes, BR [bc] BR00000531535, B [bc] 00000531535 as image, K [bc] K000174303 n.v., K [bc] K000174303 as image).

Habitat and distribution. This species is found in humid Atlantic forest vegetation in Rio de Janeiro State in southeastern Brazil; it is so far documented only from the type collection, and the elevation where it was found not noted.

Discussion. *Palicourea apiculata* is characterized by its rather large shiny leaves that are long-acuminate at the apex, its inflorescences with the basalmost pair of secondary axes markedly longer than the other secondary axes and numerous small flowers that are subsessile in congested small groups, and its small corollas (tubes 1–1.5 mm long and lobes ca. 1 mm long) with well-developed linear appendages on the abaxial surface of the lobes. This species is so far only documented by the type collection. A description of *Pal. apiculata* was presented by Müller (1881: 300–301, as *Psychotria apiculata*). This species is similar to *Pal. mamillaris*; *Pal. mamillaris* can be recognized by its leaves that are generally acute at the apex or abruptly narrowed here into a shortly acuminate tip and its corolla lobes that are abaxially smooth or have only a low, rounded thickening. These two species are separated provisionally here, and further study of them including field observations will clarify their status. *Palicourea apiculata* has sometimes been misidentified as *Psy. myriantha* Müll. Arg., which is here considered a synonym of *Pal. mamillaris*.

Three duplicates of the type collection of *Psychotria apiculata* have been seen: one in the herbarium at G where Müller worked; one at BR that apparently was part of Martius's herbarium and was annotated with this name in Müller's handwriting; and one at K. However, the collection *Riedel 360* contains two species, which Müller separated and named as *Psy. apiculata* and *Psy. segregata* Müll. Arg. Thus some of the duplicates of *Riedel 360* represent type material of *Psy. apiculata*, and others represent type material of *Psy. segregata* (which is here treated as a synonym of *Pal. malaneoides*). Some of these duplicates are labeled as *Riedel 360*, while others are labeled as *Riedel 360 p.p.*, and the labeling does not correspond to the species identification or name given by Müller. These two species can be separated morphologically as outlined in the Key to Species above, and the type attributions for *Riedel 360* duplicates that were not

annotated by Müller are based here on their species identification. With respect to *Psy. apiculata*, the *Riedel 360* specimen at K does represent *Psy. apiculata* and thus is an isotype of this species, but this K specimen has been misidentified as *Psy. segregata*, probably based on its collection number, and this misidentification has generated confusion over the identities of these two names. The specimen at G where Müller worked was annotated as *Psy. apiculata* in his handwriting and is here considered the holotype.

3. Palicourea brevicollis (Müll. Arg.) C. M. Taylor, comb. nov. Basionym: *Psychotria brevicollis* Müll. Arg., Flora 58: 548, 552. 1876. *Uragoga brachythere* Kuntze, Revis. Gen. Pl. 2: 955. 1891, replacement name, not *Uragoga brevicollis* (Müll. Arg.) Kuntze, 1891, which was based on *Mapouria brevicollis* Müll. Arg., 1876. TYPE: Brazil. Minas Gerais: Caldas, s.d., *A. F. Regnell III.116 p.p.* (lectotype, designated here, BR [barcode] BR00000531615, BR [bc] BR00000531615 as image).

Psychotria regnellii Müll. Arg., Flora 58: 548, 552. 1876. *Uragoga regnellii* (Müll. Arg.) Kuntze, Revis. Gen. Pl. 2: 952. 1891. TYPE: Brazil. Minas Gerais: Caldas, s.d., *A. F. Regnell III.116 p.p.* (lectotype, designated here, BR [barcode] BR00000531569, BR [bc] BR00000531569 as image; isolectotypes, BR [bc] BR00000531648, BR [bc] BR00000531648 as image, C n.v., C as photo F neg. 22849 at MO-1695327).

Habitat and distribution. This species is known from secondary and perhaps also primary humid Atlantic forest vegetation at 150–750 m in southeastern Brazil (Minas Gerais to Rio Grande do Sul) and southward from there through Paraguay to northern Argentina (Corrientes, Misiones).

Discussion. *Palicourea brevicollis* is characterized by its somewhat small to medium-sized leaves; its stipules with a well-developed truncate sheath and two well-developed linear lobes on each interpetiolar side; its somewhat short pyramidal inflorescences with reduced bracts; its rather small corollas (tubes 1.5–2 mm long and lobes 1.5–2 mm long); and its weakly didymous fruits with two longitudinally ridged pyrenes. Descriptions of this species as it is circumscribed here were presented by Müller (1881: 298–299, as *Psychotria regnellii*) and Taylor (2007: 395, as *Psy. brevicollis*), and illustrations were presented by Müller (1881: tab. 43 fig. 2, as *Psy. regnellii*, and tab. 45, as *Psy. brevicollis*). The description of *Psy. brevicollis* presented by Müller (1881: 298), however, was apparently based on specimens of what are here considered two species, *Pal. brevicollis* and *Pal. mamillaris*. *Palicourea brevicollis* is apparently a rather common shrub where it occurs. It is generally similar to *Pal. mamillaris*; however, *Pal. mamillaris* is a more robust species with smaller flowers (see details in the Key to Species) that is also found in Brazil but mostly to the north of *Pal. brevicollis*. *Palicourea brevicollis* was included within the circumscription of *Pal. mamillaris* (under the name *Psy. myriantha*) by Dillenberg and Porto (1985), Smith and Downs (1956), and Delprete et al. (2005), but these two species have been separated by other authors (e.g., Müller, 1881; Taylor, 2007). Bacigalupo et al. (2008) catalogued both *Psy. brevicollis* and *Psy. myriantha* as accepted names for the same species, with incomplete geographic distributions and inaccurate literature citations for each name, due to the conflicting but incompletely explained taxonomies used by different authors (this is not a rare problem in floristic catalogues). The illustrations presented by Smith and Downs (1956: unnumbered insert before p. 51, and fig. 15a–c) and Delprete et al. (2005: 574, fig. 97) show *Pal. brevicollis* as circumscribed here, although the corolla lobes are inaccurately shown as smooth abaxially in both of these figures.

Psychotria brevicollis was described based on two syntype collections from Minas Gerais, a flowering collection of Warming's from Lagoa Santa, and some duplicates of the collection *Regnell III.116* from Caldas. However, some other duplicates of *Regnell III.116* were separated by Müller as the type collection of *Psy. regnellii*. *Psychotria regnellii* and *Psy. brevicollis* were described simultaneously and were distinguished only based on the shape of the anthers: two times as long as wide in *Psy. brevicollis* versus "2 3/2" to 3 times as long as wide (Müller, 1876: 548) in *Psy. regnellii*. This first measurement given for *Psy. regnellii* clearly is a typographical error, perhaps for "2 2/3." Variation in anther shape has not been studied within individual Rubiaceae species, and it has not been used by other authors. It seems likely that in addition to any natural variation in anther shape, there is artificial variation caused by drying conditions of herbarium specimens as well as the false differences due to comparing anthers of different developmental stages. Müller worked entirely from herbarium material, in which determination of developmental stage is often difficult because the flower buds of *Palicourea* characteristically open prematurely when put into the plant press (C. M. Taylor, pers. obs.), so that well-developed buds can be easily confused with mature flowers.

Clarification of the identities of *Psychotria brevicollis* and *Psy. regnellii* based on their type specimens is problematic. The two syntype collections of *Psy. brevicollis* are problematic for the identity of this species, because the Warming collection corresponds to *Palicourea mamillaris* as circumscribed here, while *Regnell III.116* corresponds to *Pal. brevicollis* as treated by recent authors. The type material of *Psy. brevicollis* is also problematic because some of the duplicates of *Regnell III.116* are type material of *Psy. brevicollis*, but others are type material of *Psy. regnellii*. All of the duplicates of *Regnell III.116* seen represent a single species according to the taxonomy in this present study. This species corresponds to Müller's circumscription of *Psy. regnellii*. Several of the duplicates were annotated as *Psy. regnellii* by him, while others were not annotated; however, this specimen set must also include some duplicates that are type material of *Psy. brevicollis*. Three duplicates of *Regnell III.116* from Martius's herbarium are deposited at BR: one of these was annotated as *Psy. regnellii* by Müller, and the other two were also annotated with this same name but later by other people. Thus one or both of these other two duplicates could be a syntype of *Psy. brevicollis*. Although Müller's concept of *Psy. brevicollis* was somewhat confused, this name has subsequently been used for a single well-circumscribed species that corresponds to his illustration (Standley, 1936b; Bacigalupo, 1952; Bernardi, 1985; Taylor, 2007; Bacigalupo et al., 2008), while the name *Psy. regnellii* has apparently not been applied to any plants since Müller's work. Thus a duplicate of the collection *Regnell III.116* is here chosen as the type of *Psy. brevicollis*, to preserve the current usage of this name. The specimen chosen as the lectotype is a fruiting collection that is annotated with this name in Müller's handwriting and agrees with his illustration of *Psy. brevicollis*. The remaining duplicates of *Regnell III.116* lack annotations by Müller as *Psy. brevicollis*, and are here considered to be isotypes of *Psy. regnellii*. The names *Psy. brevicollis* and *Psy. regnellii* were synonymized previously by Taylor (2007).

In addition to Müller's accurate illustration of *Palicourea brevicollis*, this species was also illustrated by him under a misidentification as *Psychotria flexuosa* Willd. (Müller, 1881: tab. 44). The name *Psy. flexuosa* is a synonym of *Psy. paniculata* (Steyermark, 1972), which can be separated from *Pal. brevicollis* by its inflorescences with the flowers distributed along well-developed, regularly dichotomous axes and its stipules that have the sheath emarginate or with broadly triangular lobes and do not expand or split with age.

4. Palicourea cajamarcana C. M. Taylor, sp. nov. TYPE: Peru. Cajamarca: San Ignacio, distr. Huarango, El Triunfo (propiedad de Edilberto Delgado), 1500–1800 m, 13 July 1996, *J. Campos, P. Díaz & W. Alorcán 2937* (holotype, MO-6404721; isotype, USM n.v.). Figure 2A–D.

Diagnosis. *Palicourea cajamarcana* C. M. Taylor is distinguished from *Palicourea amita* (Standl.) C. M. Taylor and *Palicourea eggersii* (Standl.) C. M. Taylor by its larger fruits and separate distribution in northern Peru, from *Palicourea amita* also by its longer corollas, and from *Palicourea eggersii* also by its glabrous stems.

Slender shrubs flowering at 0.6 m tall, to 4 m tall; stems quadrangular to subterete, glabrous. Leaves opposite; blades elliptic to ovate, 4.5–22 × 2–9.5 cm, at base acute to broadly obtuse then sometimes narrowed and attenuate, at apex acute to usually acuminate with tips 0.5–2.5 cm, drying papery, adaxially glabrous, abaxially glabrous or sometimes ciliolate in a line along each side of costa; secondary veins 6 to 10 pairs, extending to very near margins then reticulating, without intersecondary veins or with 1 to 3 short intersecondary veins between each pair of secondary veins, adaxially costa prominulous and remaining venation plane or sometimes secondary veins prominulous, abaxially costa prominent, secondary veins prominulous, and tertiary venation well-developed, subparallel, and thinly prominulous; margins thinly cartilaginous; petioles 0.5–1.5 cm, glabrous; stipules persistent, fused around stem, sheath 1–4 mm, truncate, smooth, with 2 lobes on each interpetiolar side, inserted at or usually just below top of sheath, narrowly triangular to linear, 1.5–7 mm, at apex acute and apparently glandular, adaxially with a deciduous linear gland half as long as lobe and inserted above base of lobe. Inflorescences terminal, racemiform to paniculiform, glabrous to puberulous, apparently green; peduncle 1.5–3.5 cm; branched portion cylindrical to pyramidal, 3–6 × 1.5–5 cm, branched to 1 to 2 orders; secondary axes 3 to 9 pairs, opposite to irregularly arranged and sometimes reduced, terminating in a glomerule or short dichasial cyme of 2 to 7 flowers; bracts subtending secondary axes triangular to ovate, 0.3–1 mm, obtuse to acute, bracts subtending flowers similar except triangular to usually narrowly triangular. Flowers sessile in groups of 2 to 5, distylous; hypanthium ellipsoid to obconic, ca. 0.8 mm, glabrous; calyx limb 0.5–0.8 mm, glabrous, lobed for 1/4–1/2 its length, lobes triangular to broadly

triangular, acute to obtuse; corolla tubular-funnelform to funnelform, white to yellow, externally glabrous, internally glabrous except pilosulous near middle of tube, tube 4.5–6 mm, weakly swollen at base, straight to weakly curved (less than 30°) at base and in tube, lobes triangular, ca. 2 mm, abaxially with medial thickening or appendage 0.2–0.6 mm, at apex obtuse and shortly galeate-hooked; anthers in long-styled form included, ca. 1.5 mm, positioned just above middle of corolla tube, in short-styled form exserted, ca. 2 mm; stigmas 2, linear, in long-styled form ca. 0.8 mm and exserted, in short-styled form ca. 1 mm and included, positioned near middle of corolla tube. Infructescences similar to inflorescences or axes becoming a little longer and thicker. Fruits subglobose to ellipsoid, oblate, or weakly didymous, 6 × 6–8 mm, glabrous, orange perhaps becoming purple-black; pyrenes 2, hemispherical, adaxially with 3 to 5 obtuse angles or broad ridges or sometimes smooth when young, adaxially plane with a medial longitudinal groove and basal pore.

Habitat, distribution, and phenology. This species is known in wet forest vegetation at 360–2000 m in northern to central Peru; it has been collected in flower in January, July, and December, and in fruit February through July.

Discussion. *Palicourea cajamarcana* is characterized by the combination of its medium-sized to rather small leaves, its stipules that have a well-developed truncate sheath and two narrow lobes on each interpetiolar side of the stem, its racemiform to paniculate inflorescences with the secondary axes often lax and usually terminating in a glomerule or short cyme, its rather well-developed corolla tubes, and its somewhat large fruits with two pyrenes that are broadly angled when mature. The fruits are described on the labels as orange or red, but it seems likely that as in other species of this group the fruits become purple-black when mature and then disappear quickly and thus have not been documented. *Palicourea cajamarcana* is best documented from Cajamarca Department in northern Peru, and the name refers to this area. It is generally similar to *Pal. amita* and *Pal. eggersii*, which are both also found in the Andes but well to the north, in Venezuela and eastern Colombia; these other two species can be recognized by their inflorescences with the secondary axes branching and bearing separated flowers along with their smaller fruits, 4–5 × 4–5 mm. Additionally, *Pal. amita* differs from *Pal. cajamarcana* in its shorter corollas, with the tubes 2–3.8 mm long, and *Pal. eggersii* differs from both of these other species in its densely strigillose stems.

Palicourea cajamarcana as circumscribed here includes some variation in leaf size and shape, from relatively smaller and elliptic to larger and ovate. Inflorescence form also varies, from racemiform with very short secondary axes to pyramidal with the secondary axes as long as the primary axis, as does corolla form, from somewhat slenderly tubular-funnelform with short abaxial thickenings on the lobes, to funnelform with well-developed cylindrical abaxial appendages. This species is also found across a relatively broad elevational range. However, no groups of plants are separable morphologically or geographically within the specimens studied, and the type collection itself shows a notable range of leaf size and shape on a single stem. Several of the specimens studied have smaller fruits than described above, ca. 5 × 6 mm, but these are interpreted as very immature and thus not included in the measurements given for the well-developed or mature fruits. One of these small-fruited specimens, *J. Schunke 5319* (F, MO), is incomplete but was annotated by Donald Simpson as a new species of *Psychotria*, with the unpublished epithet "pervenulosa." The identity of this collection and Simpson's name has long been problematic, but this specimen matches *Pal. cajamarcana*. Simpson's name "pervenulosa" has been used in sched. for several different species and is therefore not adopted here due to the confusion that has surrounded the identity of this name. Simpson's unpublished name has been confused in particular with *Psy. venulosa* Müll. Arg., which is related to *Psy. deflexa* rather than species of *Palicourea* sect. *Nonatelia* (Steyermark, 1972). *Psychotria venulosa* can be separated from *Pal. cajamarcana* by its smaller stipules, with the sheath 0.5–1 mm long and lobes 0.8–2 mm long, its smaller corollas, with tubes 1.5–2 mm long, and its didymous smaller fruits, ca. 3 × 5 mm, that are white or bright blue at maturity.

Paratypes. PERU. **Amazonas:** prov. Bagua, 12 km E La Peca (by trail), *P. Barbour 2669* (MO); prov. Bongará, distr. Sipabamba, Shilla, *K. Young & M. Eisenberg 351* (MO, USM n.v.), distr. Yambrasbamba, along partially completed rd. past Cpto. Esperanza, ca. Km. 359, *S. S. Tillett 673-363* (US). **Cajamarca:** Santa Cruz, Bosque de Monteseco, *A. Sagástegui A., E. García & S. Leiva 12406* (HUT n.v., MO), *S. Leiva G., E. Rodríguez & E. López 1747* (MO); prov. San Ignacio, Huarango–San Martín, *R. Vásquez, A. Vásquez & P. López 20821* (MO). **Huánuco:** prov. Huánuco, distr. Chinchao, camino Hda. Derrepente (margen derecha río Derrepente), *J. Schunke V. 5319* (F, MO); prov. Leoncio Prado, distr. José Crespo y Castillo, Quebrada Sangapilla, ca. Aucayacu, *J. Schunke V. 9893* (MO). **Pasco:** distr. Huancabamba, camino Pozuzo, *R. Rojas, M. Huaman, A. Peña & J. Mateo 2499* (HOXA, MO, USM n.v.); distr. Pozuzo, zona amortiguamiento y Parque Nac. Yanachaga–Chemillén, parte alta Puesto de Control Huampal, *A. Monteagudo, C. Mateo & G. Ortiz 4852* (HOXA, MO, USM

n.v.), *A. Monteagudo, J. L. Mateo & R. Francis 12440* (HOXA, MO, USM n.v.), *A. Monteagudo, J. L. Mateo & R. Francis 12447* (HOXA, MO, USM n.v.), *A. Monteagudo & V. Flores 16253* (HOXA, MO, USM n.v.); Parque Nac. Yanachaga–Chemillén, sector Pan de Azúcar, *A. Monteagudo, G. Ortiz & R. Francis 5055* (HOXA, MO, USM n.v.), *L. Valenzuela, K. Durand, G. Shareva & R. Zehnder 20917* (HOXA, MO, USM n.v.).

5. Palicourea carnosocarpa (Dwyer & M. V. Hayden) C. M. Taylor, comb. nov. Basionym: *Psychotria carnosocarpa* Dwyer & M. V. Hayden, Ann. Missouri Bot. Gard. 55(1): 41. 1968. TYPE: Panama. Chiriquí: Francés Arriba School, ca. 14 mi. N David, 1200 ft., 14 Dec. 1966, *W. H. Lewis, D. Burch, J. D. Dwyer, T. S. Elias, N. Escobar, R. L. Oliver & K. R. Robertson 964* (holotype, MO-1955154).

Psychotria taurina Dwyer, Ann. Missouri Bot. Gard. 67(2): 432. 1980. TYPE: Panama. Bocas del Toro: vic. Chiriquí Lagoon, Fish Creek mtns., 16 Apr. 1941, *W. von Wedel 2240* (holotype, MO-1245978).

Habitat and distribution. This species is known from wet lowland forest at 0–400 m in western Panama (Bocas del Toro, Chiriquí) and western Colombia (Valle del Cauca).

Discussion. *Palicourea carnosocarpa* is characterized by its dense strigose to pilose pubescence, its medium-sized leaves, its stipules with well-developed truncate sheaths and narrow, rather short lobes, its pyramidal inflorescences with the flowers sessile and enclosed by rather well-developed bracts, its rather small corollas (with tubes ca. 3 mm long and lobes ca. 1.5 mm long) with short appendages on the abaxial surfaces of the lobes, and its medium-sized fruits with two pyrenes that are smooth abaxially. The individual flowers and also the flower groups are enclosed by several bracts 2–3 mm long, an arrangement that is common in *Palicourea* but so far unique in *Palicourea* sect. *Nonatelia*. *Palicourea carnosocarpa* is not well documented. A description was presented by Lorence et al. (2012: 222, as *Psychotria carnosocarpa*), and *Psy. taurina* was formally synonymized there. *Palicourea carnosocarpa* is generally similar to *Pal. racemosa*, but the flowers of *Pal. racemosa* are subtended only by reduced bracts, less than 1 mm long when fully developed.

6. Palicourea dodsoniana C. M. Taylor, sp. nov. TYPE: Ecuador. Los Ríos: rd. Santo Domingo–Quevedo, Km. 47, Río Palenque Science Center, 00°35′S, 79°22′W, 200 m, 18 Nov. 1991, *C. Persson, C. Gustafsson, B. B. Klitgaard & E. Wilson 63* (holotype, MO-04642154; isotypes, QCA n.v., S n.v.). Figure 2E, F.

Diagnosis. *Palicourea dodsoniana* C. M. Taylor is distinguished from *Palicourea stenostachya* (Standl.) C. M. Taylor by its flowers that are separated on shortly developed inflorescence axes, its corollas bent at 90° at the base and also curved 90° in the tube, its smaller fruits, and its range in western Ecuador.

Shrubs flowering at 0.5 m tall, to 5 m tall; stems quadrangular, densely puberulous to strigillose. Leaves opposite; blades elliptic, 8.5–22 × 4–10 cm, at base acute to obtuse, at apex acuminate with tip 0.5–2 cm, drying papery, adaxially glabrous, abaxially puberulous on veins and glabrous to puberulous on lamina; secondary veins 7 to 12 pairs, extending to near margins then reticulated or sometimes looping to interconnect, without intersecondary veins, without domatia, adaxially venation plane or sometimes costa prominent and secondary and tertiary veins impressed and/or thinly prominulous, abaxially costa and secondary veins prominent and tertiary venation well-developed, subparallel, and thinly prominulous; margins thinly cartilaginous; petioles 0.8–4 cm, densely puberulous or strigillose to glabrescent; stipules persistent, fused around stem (i.e., with intrapetiolar portion well-developed), puberulous to strigillose, with sheath 1.5–5 mm, truncate, smooth or with longitudinal ridges extending below lobes, on each interpetiolar side with lobes 2, narrowly triangular, 4–9 mm, inserted at top of sheath, acute, becoming indurate and glabrescent with age, adaxially at base with 2 to 5 thickened glands ca. 1 mm, these persistent and becoming indurate. Inflorescences terminal and sometimes also in axils at uppermost node, racemiform, densely strigillose to puberulous or hirtellous, apparently green; peduncle 0.8–4 cm; branched portion cylindrical to narrowly pyramidal, 3–12.5 × 1.5–2.5 cm, branched to 2 to 3 orders; secondary axes 8 to 16 pairs, opposite to irregularly arranged, each axis terminating in a dichasial cyme of 3 to 7 flowers; bracts subtending secondary axes triangular, 1–3 mm, and acute or sometimes absent; bracts subtending flowers 1 to 3 per flower, narrowly triangular to linear, 0.5–1 mm, acute. Flowers sessile, whether distylous or isostylous unknown; hypanthium cylindrical to obconic, ca. 0.8 mm, densely puberulous to glabrescent; calyx limb divided nearly to base, puberulous to glabrescent, lobes 5, triangular to ovate, 0.3–0.5 mm, acute to obtuse; corolla funnelform, white, externally puberulous with trichomes uniformly distributed to arranged in longitudinal lines, internally glabrous except densely pilose in

upper third of tube, tube ca. 3.5 mm, at base gibbous (i.e., asymmetrically swollen) and bent ca. 90° opposite the swelling with this bent portion ca. 1.5 mm, then curved back ca. 90° with this part ca. 2 mm, lobes 5, triangular, ca. 1.5 mm, acute, adaxially shortly hooked, abaxially with puberulous, conical to linear, medial appendage 0.3–0.5 mm; anthers ca. 1.2 mm, exserted; stigmas not seen; disk 5-lobed. Infructescences similar to inflorescences. Fruits oblate, 3–5 × 5–6 mm, orange probably becoming purple-black, glabrescent; pyrenes 5, wedge-shaped, abaxially with 2 to 3 obtuse to acute longitudinal ridges, with lateral faces flat and smooth, with adaxial face (i.e., where sides meet) narrow, flat to sulcate.

Habitat, distribution, and phenology. This species is known from wet forest vegetation at 100–600 m in central western Ecuador; it has been collected in bud in October, in flower in November, and with apparently mature fruits in June and July.

Discussion. *Palicourea dodsoniana* is distinguished by the combination of its medium-sized leaves with the characteristic venation of *Palicourea* sect. *Nonatelia*, its well-developed narrow stipule lobes, its racemiform inflorescences with a narrowly cylindrical overall form, its relatively small flowers borne in dichasial cymes, its corollas that are markedly and asymmetrically swollen and bent at the base and have well-developed abaxial appendages on the lobes, and its fruits with five triangular pyrenes with rounded to sharply angled abaxial ridges. The fruits are described on the labels as orange, but it seems likely that as in other species of this group the fruits become purple-black when mature, and then are removed quickly by frugivores and have not been documented. Only one collection with fully developed flowers has been seen; these flowers are similar to the short-styled flowers of distylous species, but more documentation is needed to determine if this species is distylous. The collection data suggest seasonality in flowering and fruiting, but the number of collections is limited. *Palicourea dodsoniana* is known only from a somewhat small area near Santo Domingo de los Colorados in west-central Ecuador and is best documented from the Río Palenque Field Station of Dr. Calaway Dodson (1928–). The specific epithet honors him.

This new species has been confused with *Palicourea stenostachya* (Fig. 2G, H), and *Pal. dodsoniana* is similar to both *Pal. stenostachya* and *Pal. subfusca*, which both are found in the Amazon and Orinoco basins and are geographically separated by the Andean cordillera from *Pal. dodsoniana*. *Palicourea dodsoniana* shares with *Pal. stenostachya* corollas that are generally similar in shape, pyrenes with well-developed abaxial ridges, and a distinctive orangish brown dried color on some specimens, but *Pal. stenostachya* can be separated by its flowers that are sessile and tightly grouped at anthesis, its longer corollas with the tubes 4.5–7 mm long and only weakly bent, and its larger fruits, ca. 6 × 6 mm. *Palicourea subfusca* can be separated from *Pal. dodsoniana* by its corollas that are generally straight or only weakly curved, its larger fruits, 5–6 × 6–7 mm, and a characteristic blackened or gray drying color.

Paratypes. ECUADOR. **Los Ríos:** along entrance rd., Río Palenque Field Station, *M. Fallen 804* (MO); Río Palenque Biol. Station, Km. 56, rd. Quevedo–Santo Domingo de los Colorados, 47 km S Santo Domingo de los Colorados, *C. H. Dodson 5898* (MO), *C. H. Dodson & A. Gentry 6316* (MO), *J. D. Dwyer 10308* (MO), *A. Gentry 9533* (MO), *A. Gentry 12004* (MO); Centinela Ridge area, 12.5 km E Patricia Pilar, *B. Hansen, R. P. Wunderlin, R. P. Sauleda, H. Luther, M. Ragan, J. Wiersema & L. Davenport 7815* (MO). **Santo Domingo de los Tsáchilas [formerly part of Pichincha]:** Santo Domingo de los Colorados, *C. Cerón & G. Benavides 6216* (MO); Santo Domingo de los Colorados, vic. Peripa SW Santo Domingo, *T. B. Croat & M. Núñez 82102* (MO); Colorado [i.e., Tsáchila] commun. Congoma Grande, Km. 23 Santo Domingo–Puerto Limón rd., *L. P. Kvist 40066* (AAU, MO, QCA); ca. 10 km E Patricia Pilar, *G. L. Webster, R. Lockwood & K. Steiner 22767* (DAV, MO).

7. Palicourea eggersii (Standl.) C. M. Taylor, comb. nov. Basionym: *Psychotria eggersii* Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 8(1): 69. 1930. TYPE: Venezuela. Distrito Federal: high ridge N Caracas, 1800 m, 27 June 1891, *H. F. A. von Eggers 13187* (holotype, F-580339 n.v., F-580339 as image; isotypes, F-59170 n.v., F-591371 n.v., F-591371 as image, US-1234586 n.v., US-1234586 as image, US-1390897 n.v., US-1390897 as image). Figure 1I, J.

Habitat and distribution. This species is known from wet forest at 750–2150 m in the Cordillera de la Costa in northern Venezuela.

Discussion. *Palicourea eggersii* is characterized by its rather small leaves; its short inflorescences that are racemiform in flower, with the secondary axes short and generally subequal, but later become pyramidal and broader in fruit as the secondary axes elongate; its flowers with usually four rather than five calyx lobes, corolla lobes, and stamens; its relatively long corollas (with tubes ca. 5 mm long) with well-developed abaxial appendages on the lobes; and its somewhat didymous fruits. The flowers of *Pal.*

eggersii have been described in the protologue and by Steyermark (1974: 1329–1331, as *Psychotria eggersii*) as consistently 4-merous and the specimens seen agree with this. However, in conflict with his own description, Steyermark in this same place (1974: fig. 208, as *Psy. eggersii*) presented an illustration of this species showing five calyx lobes, corolla lobes, and stamens. Species of *Palicourea* with 5-merous flowers occasionally produce a few 4-merous and 6-merous flowers, and species that are basically 4-merous also sometimes produce a few flowers with different merosity; inconveniently, Steyermark's illustration seems to have been drawn from just such a variant plant. Steyermark also clarified in that same place that the ridge mentioned in the type locality is called the Fila del Avila. *Palicourea eggersii* is similar to *Pal. amita*; *Pal. amita* can be recognized by its flowers that are variously sessile and pedicellate and borne in loose groups or separated along axes, and its smaller corollas, about half as large as those of *P. eggersii*, with five abaxially smooth lobes. *Palicourea eggersii* is also similar to *Pal. meieri* and *Pal. locellata*, both of which are newly described in this article. For their differences, see the discussion under each of these new species.

There are three specimens of the type collection of *Psychotria eggersii*, *Eggers 13187* deposited at F, and in the protologue Standley explicitly designated the specimen F-580339 as the type of this name. The other duplicates of this collection at F are fragments, and the places of deposit of the specimens from which these pieces were taken are not noted. Following standard procedure of Standley's time, several separate specimens are mounted on a single sheet, and each individual specimen has a unique F accession number. In the protologue Standley (1930: 70) noted that an isotype was deposited at "W," and this istoype has sometimes been cited subsequently as deposited at the institution that formally holds the acronym W today, in Vienna, Austria. However, Standley used the acronym "W" for the Smithsonian Institution in Washington, D.C. (Standley, 1930: 4).

8. Palicourea fissistipula (Müll. Arg.) C. M. Taylor, comb. nov. Basionym: *Psychotria fissistipula* Müll. Arg., Flora 59: 547, 551. 1876. *Uragoga niedenzuana* Kuntze, Revis. Gen. Pl. 2: 957. 1891, replacement name, not *Uragoga fissistipula* (Müll. Arg.) Kuntze, 1891, which is based on *Rudgea fissistipula* Müll. Arg., 1873. TYPE: Brazil. s. loc., s.d., *F. Sellow s.n.* (holotype, B† n.v., B† as photo F neg. 493 at MO-1695206; lectotype, designated here, G [barcode] G00300759, G [bc] G00300759 as image).

Psychotria trichostyla Müll. Arg., Fl. Bras. 6(5): 289. 1881, syn. nov. *Uragoga trichostyla* (Müll. Arg.) Kuntze, Revis. Gen. Pl. 2: 963. 1891. TYPE: Brazil. Rio de Janeiro, s.d., *C. Martius s.n.* (lectotype, designated here, G [barcode] G00300760, G [bc] G00300760 as image).

Habitat and distribution. This species is known from humid Atlantic forest vegetation at perhaps 0–800 m in southeastern Brazil (Espírito Santo, Minas Gerais, Rio de Janeiro).

Discussion. *Palicourea fissistipula* is characterized by its stipules that have well-developed truncate sheaths and lobes that are divided, somewhat irregularly, into two to five well-developed linear segments; its leaves that are long-acuminate at the apex; its pyramidal inflorescences with generally well-developed peduncles; its corolla lobes that are abaxially smooth or have only a short rounded thickening; and its fruits with two pyrenes. The stipule lobes are entire and parallel-sided at the base, but then are divided in their upper portions. A description of this species was presented by Müller (1881: 290, as *Psychotria fissistipula*). *Palicourea fissistipula* is similar to *Pal. octocuspis*. These two species are separated here somewhat arbitrarily by their corollas, with the lobes abaxially smooth or thickened to very shortly appendaged in *Pal. fissistipula* in contrast to the lobes with well-developed linear appendages in *Pal. octocuspis*. The length of the calyx limb on these plants seems to be inversely correlated with the development of the corolla lobe appendages, with the limb longer in *Pal. fissistipula*, 0.5–0.6 mm long, versus shorter in *Pal. octocuspis*, 0.3–0.5 mm long. *Palicourea fissistipula* has been collected less often and over smaller overall range than *Pal. octocuspis*. The separation of these species deserves further study including field observations.

One collection was cited in the protologue of *Psychotria fissistipula*, an unnumbered Sellow collection without locality information. Two duplicates of this collection have been seen: one is a full specimen that was formerly deposited at B and has now been destroyed, and an incomplete specimen is in Müller's herbarium at G. The destroyed B specimen is documented by a photo, and apparently Müller's incomplete specimen comprises pieces taken from it. No herbarium of deposit was cited by Müller for the type of *Psy. fissistipula*. The incomplete specimen at G includes two leaves, a node with a stipule, and part of an inflorescence with mature corolla buds. This specimen clearly constitutes part of the original material studied by Müller, and does show the basic characters that diagnose *Psy. fissistipula*. However,

the protologue description details characters that are not represented on the incomplete G specimen, thus the description of this species was not based only on the material at G. The full sheet at B thus could be considered the original holotype, or at least casts doubt on whether the specimen at G can be considered the holotype. Therefore, the specimen at G is here designated as the lectotype of this species, rather than being considered the holotype.

Two unnumbered Martius collections were cited in the protologue of *Psychotria trichostyla*, one from Rio de Janeiro and the other from Ouro Preto in Minas Gerais. Only one of these has been located, a Martius collection from Rio de Janeiro that is deposited in Müller's herbarium at G. This specimen is adequate to show the identity of this name and is here designated as its lectotype.

9. Palicourea forsteronioides (Müll. Arg.) C. M. Taylor, comb. nov. Basionym: *Psychotria forsteronioides* Müll. Arg., Flora 59: 550, 553. 1876. *Uragoga forsteronioides* (Müll. Arg.) Kuntze, Revis. Gen. Pl. 2: 960. 1891, as "*forsteroniodes*." SYNTYPES: Brazil. Probably Rio de Janeiro State, *H. W. Schott s.n.* (not located); São Paulo, Juqueri, *P. W. Lund s.n.* (not located).

Habitat and distribution. This species is found in humid Atlantic forest vegetation at 700–1600 m in southeastern Brazil (Minas Gerais, São Paulo).

Discussion. *Palicourea forsteronioides* is characterized by its generally rather dense pilosulous to hirtellous pubescence on the stems, stipules, leaves, and inflorescences; its stipules that have truncate sheaths and well-developed lobes; its pedunculate spiciform inflorescences with the flowers sessile in subsessile glomerules or groups of glomerules that are borne directly from the primary axis; its linear to narrowly triangular bracts 0.5–5 mm long, with some of them usually exceeding the calyx limbs in the flowers they subtend; its densely hirtellous calyx limbs with linear to narrowly triangular lobes, 0.5–2 mm long, that are unequal on an individual flower; its small corollas (with tubes ca. 1.5 mm long and lobes ca. 1.5 mm long) that have abaxial appendages ca. 0.3 mm long on the lobes; and its fruits with two pyrenes. The inflorescences vary from very congested, with the flower glomerules all sessile and closely grouped together so the primary axis is hardly visible, to laxer with the flower glomerules well separated along the primary axis. A description of *Pal. forsteronioides* was presented by Müller (1881: 306–307, as *Psychotria forsteronioides*).

Palicourea forsteronioides is similar to *Pal. malaneoides*, and these have been confused and/or combined by some recent taxonomists (e.g., Standley, in sched., as *Psy. forsteronioides*; WCSP, 2014, as *Psy. malaneoides*; Taylor, 2007, as *Psy. forsteronioides*). The description of *Psy. forsteronioides* presented by Taylor (2007: 399) is based on a set of plants that comprises both of these species. Also Kuntze (1891) did not accept and transfer to *Uragoga* the name *Psy. malaneoides* because he considered that name a synonym of *Psy. segregata* or *Psy. forsteronioides*. However, two different species can be separated here and can be distinguished following Müller's original distinctions: *Pal. forsteronioides* can be recognized by its densely hirtellous calyx limbs with narrow lobes of unequal length, versus calyx limbs glabrescent to strigillose or moderately hirtellous with deltate lobes of generally equal length in *Pal. malaneoides*. It is possible these species differ also in corolla size, as outlined in the Key to Species, above; that key separates the specimens studied, but relatively few flowering specimens of either species have been seen and most do not have mature corollas, so the full range of corolla size in these plants is not clear. *Palicourea malaneoides* is more widely distributed and more commonly collected than *Pal. forsteronioides*. Further study is needed, including field observations, to fully evaluate the status of these species.

Two syntypes from Rio de Janeiro were cited in the protologue of *Psychotria forsteronioides* (Müller, 1876), an unnumbered Schott collection and an unnumbered Lund collection. Neither of these has been located in this study, so a neotype may be needed, but further study is needed to resolve this. Müller treated this species again in more detail in his floristic work (1881), and an additional collection of this species was cited there, *Glaziou 6566*. A duplicate of this specimen was deposited at B and has been been destroyed, but this specimen is documented with a photo (F neg. 499 at MO-1695212). *Glaziou 6566* has been referred to as a voucher for the identity of the name *Psy. forsteronioides* in its broader circumscription, which included both *Psy. forsteronioides* and *Psy. malaneoides*. However, this photograph does not provide enough detail to conclusively identify which of these two species this plant represents. A duplicate of this collection at P (P [barcode] P03646394 n.v., P [bc] P03646394 as image) does have adequate detail, and this duplicate represents *Palicourea forsteronioides*. If the original syntypes of *Psy. forsteronioides* cannot ultimately be located, then the *Glaziou 6566* specimen at P is a good candidate for a neotype.

10. Palicourea locellata C. M. Taylor, sp. nov. TYPE: Colombia. Cundinamarca: mpio. Ubala, vereda Campo Hermoso, hacia el Retiro, cuenca del río Guavio, 4°45′49″N, 73°21′45″W, 1820 m, 3 June 1998, *J. Fernández, L.-C. Cárdenas, D. Vera & V. Paez 16420* (holotype, COL-480439). Figure 3.

Diagnosis. *Palicourea locellata* C. M. Taylor is distinguished from *Palicourea eggersii* (Standl.) C. M. Taylor and *Palicourea meieri* C. M. Taylor by its larger stipules that are fused into a prolonged tube that splits longitudinally, its longer bracts, and its pyrenes with one or more air chambers.

Shrubs and small trees to 4 m tall; stems terete, glabrous. Leaves opposite; blades elliptic to lanceolate or ovate, 6.3–18 × 1.7–6.8 cm, at base cuneate to obtuse or rounded, at apex acuminate with tips 0.8–1.5 cm, drying papery, adaxially glabrous, abaxially glabrous or often puberulous on principal veins; secondary veins 9 to 13 pairs, weakly looping to interconnect near or at margins, without intersecondary veins or with 1 to 3 weak intersecondary veins (or perhaps well-developed tertiary veins), without domatia, adaxially costa prominent and sharp and remaining venation plane to thickened, abaxially costa and secondary veins prominent and intersecondary veins, tertiary venation, and sometimes some quaternary venation prominulous; margins thinly cartilaginous; petioles 0.6–1.2 cm, glabrous; stipules deciduous via fragmentation, glabrous, fused around stem into a slender lanceoloid tube, 9–18 mm, smooth, with 1(or 2) longitudinal slits opening as stem enlarges, at top subtruncate with 6 to 12 linear glands, these 2–2.3 mm, arranged in 2 closely set groups, persistent. Inflorescences terminal, paniculiform, puberulous, color not noted; peduncle 1–2.5 cm; branched portion pyramidal, 4–7 × 3.5–6 cm, branched to 3 to 4 orders; secondary axes 3 to 6 pairs, opposite to irregularly alternate and subverticillate; bracts narrowly triangular to narrowly ligulate, glabrescent, obtuse to acute, those subtending secondary axes 4–9 mm, those subtending higher-order axes mostly reduced, those subtending flowers 2–5 mm. Flowers sessile, solitary and in groups of 2 to 3 on dichasial axes, each subtended by 1 or 2 bracts, whether distylous or isostylous unknown; hypanthium ellipsoid to subglobose, ca. 0.8 mm, densely puberulous; calyx limb 0.2–0.5 mm, puberulous, 4- or irregularly 5-lobed for 1/3–1/2 its length, lobes triangular, obtuse to acute or sometimes acuminate; corolla tubular-funnelform, white to cream, externally puberulous, in bud with tube to 7 mm, straight to weakly swollen at base, 1–1.2 mm diam. near middle, internally glabrous except with hirtellous ring ca. 2.5 mm wide near middle, lobes 4, ligulate, to 3 mm, abaxially smooth, apparently obtuse; anthers 4, ca. 2 mm, with filaments ca. 4 mm and inserted near top of corolla tube; stigmas 2, linear, ca. 2 mm, positioned just below top of corolla tube. Infructescences similar to inflorescences. Fruits subglobose to oblate, ca. 4 × 4.5 mm, glabrous, color not noted; pyrenes 2, generally hemispherical, abaxially with ca. 3 broadly angled longitudinal ridges, adaxially with 1 or 2 rounded chambers, margins with prolonged longitudinal flange.

Habitat, distribution, and phenology. This species is known from wet forest at 1295–1820 m on the eastern slopes of the Cordillera Oriental of the Andes in Colombia; it has been collected in flower in June and July, and in fruit in July.

Discussion. *Palicourea locellata* has the characters of *Palicourea* sect. *Nonatelia* and also has several features that are unusual within *Palicourea* as well as within this group. In particular, its stipules and pyrenes are unusual. The stipules of *Pal. locellata* are fused into a well-developed, rather slender tube that is a little broadened near the base and truncate or perhaps shallowly bilobed at the top (Fig. 3B, C). The top of this stipule tube bears two groups of well-developed, persistent, linear or cylindrical glands, which apparently correspond to the glands that are inserted on the adaxial surfaces of the sheath and/or lobes of other species of this group. This stipule tube splits longitudinally for part or most of its length along one or apparently sometimes two sides as the stem enlarges. This splitting produces a generally spathaceous form, although the tube is apparently initially open at the top rather than fully fused as in truly spathaceous stipules. This stipule form is so far unique in *Palicourea*; similar stipules are found in *Gaertnera* Lam., though in those the stipule top has one to several lobes that are not glandular (Malcomber & Taylor, 2009).

The pyrenes of *Palicourea locellata* are generally hemispherical in shape with broad longitudinal angles on the outer (abaxial) surface; however, in contrast to other species of *Palicourea* the seed fills only part of the interior area. The seed is situated in a chamber of the pyrene that occupies the abaxial half or three fourths of the interior, and the adaxial portion of the pyrene is apparently empty and constitutes an air chamber (Fig. 3E). This empty portion is entire or divided into two smaller empty chambers. Similar air chambers are known in some species of *Carapichea* Aubl. (e.g., *C. guianensis* Aubl.; Taylor & Gereau, 2013, fig. 1G). Additionally, in *Pal. locellata* the

longitudinal margins of the pyrene walls are prolonged into a wing or flange that extends outward in an angled adaxial direction. Such flanges are found in several *Palicourea* species (e.g., *Pal. pittieri* Standl., Piesschaert, 2001: 209. fig. 8.23F) but are usually extended straight or are tightly incurved. When the spreading pyrene flanges of the two pyrenes of *Pal. locellata* are in contact in the intact fruit, they apparently form another longitudinal air chamber along each side of the fruit. The species epithet refers to these various chambers or cells inside the pyrenes and fruits. The function of these structures is unknown.

Palicourea locellata is similar to two other species of this group from montane areas in the northeastern Andes, *Pal. eggersii* and *Pal. meieri*. Both of these other species can be separated from this new species by their smaller stipules, which have truncate sheaths 1–2 mm long and narrowly triangular lobes 0.5–2 mm long, by their shorter bracts, 0.5–2 mm long, and by their pyrenes without air chambers. Additionally, *Pal. eggersii* can be recognized by its corollas with abaxial horns on the lobes and *Pal. meieri* by its 5-merous flowers.

Paratypes. COLOMBIA. **Cundinamarca:** mpio. Ubala, vereda Campo Hermoso, hacia el Retiro, cuenca río Guavio, *J. Fernández, L.-C. Cárdenas, D. Vera & V. Paez 16379* (COL), *J. Fernández, L.-C. Cárdenas, D. Vera & V. Paez 16437* (COL), *J. Fernández, L.-C. Cárdenas, D. Vera & V. Paez 16481* (COL). **Meta:** mpio. Lejanias, veredas El Triunfo y el Jardín, por camino de herradura Alto El Masato–escuela El Triunfo, *R. López C., Y. Marínez, N. Cruz, M. A. Pinzón & R. Pinzón 4145* (COAH).

11. Palicourea malaneoides (Müll. Arg.) C. M. Taylor, comb. nov. Basionym: *Psychotria malaneoides* Müll. Arg., Flora 59: 550, 553. 1876. *Psychotria malaneoides* var. *glabrescens* Müll. Arg., Flora 59: 553. 1876. TYPE: Brazil. s. loc., s.d., *J. B. E. Pohl 4365* (lectotype, designated here, G [barcode] G00300553, G [bc] G00300553 as image; isolectotypes, W-0045849 n.v., W-0045849 as image, W-0045850 n.v., W-0045850 as image).

Psychotria malaneoides var. *vestita* Müll. Arg., Flora 59: 553. 1876. TYPE: Brazil. s. loc., s.d., *F. Sellow s.n.* (holotype, G [barcode] G00300554, G [bc] G00300554 as image; isotype, K [bc] K000015421 n.v., K [bc] K000015421 as image).

Psychotria segregata Müll. Arg., Flora 59: 549, 552. 1876. *Uragoga segregata* (Müll. Arg.) Kuntze, Revis. Gen. Pl. 2: 962. 1891. TYPE: Brazil. Rio de Janeiro: Mandioca, Dec. 1822, *L. Riedel 360 p.p.* (holotype, G [barcode] G0030059, G [bc] G0030059 as image; isotypes, BR [bc] BR00000532615, BR [bc] BR00000532615 as image, F-617766 n.v., F-617766 as image).

Habitat and distribution. This species is known from humid Atlantic forest vegetation at 200–1400 m, in southeastern Brazil from Minas Gerais to Santa Catarina States.

Discussion. *Palicourea malaneoides* is characterized by its stems, stipules, and leaves that are glabrous to pilosulous, in contrast to its densely hirtellous inflorescences; its stipules that have truncate sheaths and well-developed lobes; its pedunculate spiciform to narrowly pyramidal inflorescences with the flowers sessile in subsessile glomerules or groups of glomerules that are borne directly from the primary axis or on shortly developed secondary axes; its narrowly triangular bracts, 0.5–2 mm long, that do not exceed the calyx limbs in the flowers they subtend; its calyx limbs that are glabrescent to strigillose or moderately hirtellous and have deltate lobes 0.5–1 mm long that are generally equal on an individual flower; its corollas that are small (with tubes 2–2.5 mm long and lobes 1.5 mm long) and have conical medial appendages ca. 0.3 mm long on the abaxial surface of the lobes; and its fruits with two pyrenes. A description and illustration were presented by Müller (1881: 306, tab. 47 fig. 1, as *Psychotria malaneoides*). *Palicourea malaneoides* is very similar to *Pal. forsteronioides*, and these have been confused and/or combined by recent taxonomists; their distinctions and shared taxonomic history are detailed in the discussion of *Pal. forsteronioides*.

The inflorescences of *Palicourea malaneoides* vary from spiciform and quite congested, with the flower glomerules all sessile on the primary axis and closely grouped along its length so that this primary axis is mostly not visible, to spiciform and elongated, with the glomerules well separated along the primary axis, to narrowly pyramidal with the basalmost one or two pairs of glomerules borne on shortly developed secondary axes. *Psychotria segregata* was described based on specimens with this last inflorescence form and was separated by this inflorescence arrangement from *Psy. malaneoides*; in that taxonomy, *Psy. malaneoides* was circumscribed to include plants with the the first two inflorescence arrangements. However, with more specimens now available, the inflorescences of *Pal. malaneoides* clearly vary in arrangement with both forms sometimes found on the same plant (e.g., *P. Dusén 14338*, MO). These names were therefore synonymized by Taylor (2007). Additional confusion about the identity and circumscription of *Psy. segregata* comes from its typification, because Müller's species *Psy. apiculata* and *Psy. segregata* were each based on some duplicates of the mixed collection *Riedel 360*. These species can be

separated as outlined in the Key to Species, above. The type status of the *Riedel 360* specimens is discussed in detail above under *Pal. apiculata*, which is presented previously in this article.

Psychotria malaneoides was originally described (Müller, 1876) with two varieties, neither of which was called "var. *malaneoides*" or explicitly designated as the typical variety. *Psychotria malaneoides* var. *vestita* was described first in the treatment, from one unnumbered Sellow collection. *Psychotria malaneoides* var. *glabrescens* was described second in this treatment, after *Psy. malaneoides* var. *vestita*, based on three syntypes: *Pohl 996*, *Pohl 4365*, and an unnumbered Riedel collection. Later, Müller treated this species in more detail in his floristic treatment (1881) and cited there an additional specimen of *Psy. malaneoides* var. *glabrescens*, *Glaziou 7683*. This Glaziou collection has been confused with type material (e.g., Taylor, in sched.) but is not a type. These two varieties have been synonymized by recent authors (Delprete et al., 2005; Taylor, 2007; Bacigalupo et al., 2008), and the species name has apparently not been typified. Müller's presentation of the typical variety was variable: sometimes he identified the typical variety only as the species (e.g., *Psy. subcrocea* Müll. Arg., Müller, 1881: 244–245), sometimes no typical variety was indicated (e.g., *Psy. malaneoides*), and sometimes it was indicated and not listed first (e.g., *Psy. rigida* Bredem. ex Schult., Müller 1881: 230–231, the typical variety here called variety δ *genuina*). Thus, Müller's presentation of *Psy. malaneoides* var. *glabrescens* as the second variety does not preclude his considering it the typical variety, and it is here considered to be the typical variety. Müller's second variety is here designated as the typical variety based on his providing a more detailed description of this in both the protologue and the floristic treatment (Müller, 1881) and an illustration (Müller, 1881: tab. 47, fig. 1), and also on Müller's annotation of the specimen *Pohl 4365* at G with only the name *Psy. malaneoides*. A complete specimen of *Pohl 4365* at G was annotated by Müller, and this is here designated as the lectotype of *Psy. malaneoides* var. *glabrescens* and therefore of *Psy. malaneoides*.

Two specimens of the type collection of *Psychotria malaneoides* var. *vestita* have been seen. One is a full sheet at K and the other is a fragmentary specimen at G that was annotated by Müller. Müller's specimen at G is adequate to demonstrate the identity of this name, and clearly was studied by him and therefore this specimen is here considered the holotype.

12. Palicourea mamillaris (Müll. Arg.) C. M. Taylor, comb. nov. Basionym: *Psychotria mamillaris* Müll. Arg., Fl. Bras. 6(5): 299. 1881. *Uragoga mamillaris* (Müll. Arg.) Kuntze, Revis. Gen. Pl. 2: 961. 1891. TYPE: Brazil. Rio de Janeiro: Itaboraí, betw. Villa Nova & Porto das Caixas, 11 Feb. 1875, *A. Glaziou 7687* (holotype, G [barcode] G00300924, G [bc] G00300924 as image; isotypes, B† n.v., B† as photo F neg. 494 at MO-1695260, R-10419 n.v., R-10419 as image).

Psychotria myriantha Müll. Arg., Flora 59: 549, 552. 1876, syn. nov., not *Palicourea myriantha* Standl., 1930. TYPE: Brazil. Praesidio de San Juan Baptista, s.d., *F. Sello 1204* (holotype, G [barcode] G00300579, G [bc] G00300579 as image; isotype, B† n.v., B† as photo F neg. 487 at MO-1695285).

Habitat and distribution. This species is known from humid Atlantic forest vegetation at 10–835 m in eastern Brazil, from Bahia and Minas Gerais to São Paulo States.

Discussion. *Palicourea mamillaris* is characterized by its rather robust and usually shiny leaves that often dry with a greenish brown color; its stipules that have truncate sheaths and narrow lobes; its pyramidal to pyramidal-cylindrical branched inflorescences with the basalmost pair of secondary axes generally longer than the other secondary axes, and the flowers numerous and tightly grouped; its small corollas (with tubes ca. 1.5 mm long and lobes ca. 1 mm long) that have the lobes abaxially thickened but not appendaged; and its fruits with two pyrenes. Descriptions of this species were presented by Müller (1881: 299–300, as *Psychotria mamillaris* and *Psy. myriantha*) and Taylor (2007: 404, as *Psy. myriantha*). *Palicourea mamillaris* is circumscribed here differently than in several previous works (e.g., Delprete et al., 2005). In the circumscription adopted in this present work, *Pal. mamillaris* includes plants found in eastern Brazil from São Paulo State north through Bahia, and it is considered separate from *Pal. brevicollis*. For details of the separation and taxonomic history of these two species, see the discussion above of *Pal. brevicollis*, presented previously in this article. The plants included here in *Pal. mamillaris* show some variation in pubescence and in inflorescence size, both the number of axes in the inflorescence and their degree of elongation. These plants vary from puberulous or glabrescent to densely pilosulous to hirtellous, and the inflorescences range from rather congested to quite lax. Possibly more than one species is included within the circumscription here of *Pal. mamillaris*, but more detailed study including fieldwork will be necessary to evaluate this. *Palicourea mamillaris* is similar to and has been

confused with *Pal. minutiflora* of Bahia; *Pal. minutiflora* can be separated by its smaller inflorescences with shorter secondary axes, longer corollas, and larger fruits, as detailed in the Key to Species, presented above.

The identity of the name *Psychotria mamillaris* has been unclear, and this name has not been cited by recent authors (e.g., Taylor, 2010). Comparison of the type specimens shows that the names *Psy. mamillaris* and *Psy. myriantha* apply to the same species, and these names are newly synonymized here. The rule of priority makes *Psy. myriantha* the correct name for this species when it is classified in *Psychotria*, but this name cannot be transferred to *Palicourea* because that epithet was previously used in *Palicourea*. Thus, the name *Psy. mamillaris* provides the correct name for this species in *Palicourea*.

A duplicate of each of the type collections of *Psychotria mamillaris* and *Psy. myriantha* is deposited in Müller's herbarium at G and annotated with the corresponding name in his handwriting, and these two specimens are presumed here to be holotypes. The name *Psy. myriantha* was apparently not transferred to *Uragoga* by Kuntze (1891) due to a confusion with *Mapouria myriantha* Müll. Arg., for which he published both the combination *U. myriantha* (Müll. Arg.) Kuntze (1891: 961) and also the replacement name *U. engleriana* Kuntze (1891: 955). For *U. engleriana* the basionym was cited as "*Mapouria myriantha* not *Psychotria myriantha*" (Kuntze, 1891: 955). Apparently *Psy. myriantha* was intended to be the basionym of *U. myriantha*, but *M. myriantha* was formally designated as the basionym of *U. myriantha* instead (Kuntze, 1891: 961). The citation of this same basionym for two different nomenclatural combinations seems to have been a typographical error.

13. Palicourea meieri C. M. Taylor, sp. nov. TYPE: Venezuela. Miranda: S del caserío El Palacio de la Providencia, 19 km (distancia aérea) al SW Ocumare del Tuy, 10°02′N, 66°56′W, 100 m, 12 May 1999, *A. Narvaez, L. Cortéz & O. Kunert 300* (holotype, VEN-433031 n.v., VEN-433031 as image; isotypes, FB n.v., MO-04973376). Figure 1E–H.

Diagnosis. *Palicourea meieri* C. M. Taylor is distinguished from *Pal. eggersii* (Standl.) C. M. Taylor by its longer stipule lobes, its flowers separated on developed axes in dichasial cymes, its shorter calyx limbs, its 5-lobed calyx and corolla, and its 5 stamens.

Shrubs and small trees flowering at 2.5 m tall, to 3 m tall; stems weakly quadrangular, densely strigillose to sparsely puberulous or glabrescent. Leaves opposite; blades elliptic, 4.5–16 × 1.7–6 cm, at base acute to obtuse, at apex acuminate with tips 0.5–1.5 cm, drying papery, adaxially glabrous, abaxially glabrescent on lamina and puberulous to strigillose on veins; secondary veins 9 to 14 pairs, weakly looping to interconnect, without intersecondary veins (with well-developed tertiary veins that sometimes resemble intersecondary veins), without domatia, adaxially with venation plane or costa impressed, abaxially with costa and secondary veins prominent and tertiary and sometimes quaternary veins prominulous; margins thinly cartilaginous; petioles 0.5–1.5 cm, densely strigillose to puberulous or glabrescent; stipules persistent, united around stem, densely strigillose, with sheath 0.8–1.2 mm, truncate, smooth or with longitudinal ridges extending below lobes, with lobes 2 on each interpetiolar side, linear to narrowly triangular, 1–2.2 mm, acute, inserted at or just below top of sheath, acute and apparently glandular at tip, old stipules with sheath becoming indurate then fragmented and lobes sometimes falling off by fragmentation. Inflorescences terminal, paniculiform, densely strigillose to pilosulous, green sometimes flushed with yellow; peduncles 1.2–2.5 cm; branched portion pyramidal, 3.5–8 × 2.5–6 cm, branched to 3 to 4 orders; secondary axes 5 to 7 pairs, opposite or irregularly subopposite to alternate and/or subverticillate; bracts subtending secondary axes triangular, 0.5–1.5 mm, acute to acuminate, bracts subtending flowers linear, 0.5–0.8 mm, acute. Flowers sessile in dichasial cymes and separated on axes to 1.5 mm, distylous; hypanthium ellipsoid to cylindrical, ca. 0.5 mm, glabrous to sparsely puberulous; calyx limb 0.1–0.3 mm, glabrescent to puberulous, lobed nearly to base, lobes 5, deltate, obtuse to acute; corolla funnelform, white to yellow, externally glabrous or lobes ciliolate or pilosulous near margins, internally glabrous except sparsely hirtellous in basal half, tube 6–7 mm, slender, swollen at base then abruptly contracted, above this contraction markedly widened and straight to weakly curved (i.e., to 30°), lobes 5, ligulate-triangular, 3–3.2 mm, at apex shortly galeate-hooked, abaxially smooth; anthers in long-styled flowers ca. 1.5 mm, included, and positioned in upper part of corolla tube, in short-styled flowers ca. 1.5 mm and exserted; stigmas 2, linear, in long-styled form ca. 0.5 mm and exserted, in short-styled flowers ca. 2 mm, included, and positioned just above middle of corolla tube; disk 2-lobed. Infructescences similar to inflorescences. Fruits ellipsoid and laterally flattened to didymous, 3 × 4–5 mm, glabrous, becoming orange then black; pyrenes 2, hemispherical, abaxially

tuberculate-roughened and with 4 to 5 obtuse, rather narrow longitudinal ridges, adaxially plane with a well-developed central longitudinal groove.

Habitat and distribution. This species is known from wet forest in northern Venezuela at 800–1370 m; it has been collected in flower in May, and in fruit in January, October, and November.

Discussion. *Palicourea meieri* is characterized by the combination of its medium-sized leaves with the characteristic venation of *Palicourea* sect. *Nonatelia*, its stipules with a truncate sheath and linear lobes, its pyramidal inflorescences with rather slender axes and the flowers borne in dichasial cymes, its relatively short calyx limbs, its rather well-developed corolla tubes, and its fruits with two abaxially ridged pyrenes. The corolla lobes are galeate with a generally rounded form at their apices, and grouped together they produce a knobbed and rather truncate apex on the flower buds. Some other species of *Palicourea* sect. *Nonatelia* have similarly truncate-knobbed corolla buds, but in those other species this shape is produced by the abaxial appendages on the corolla lobes, not the tips of the lobes as in *Pal. meieri*. Specimens of *Pal. meieri* sometimes dry with a marked reddish brown color, but others dry with a clear green color. *Palicourea meieri* is widely distributed in the mountains of Venezuela but apparently not common locally. This species was first noted as possibly new by Steyermark (in sched., *J. Steyermark & R. Liesner 120765*, MO), but he did not suggest a name for it. *Palicourea meieri* has been particularly well documented by the botanical explorations of Winfried Meier (Albert-Ludwigs Universität, Freiburg, Germany, 1960–), who is honored in the species epithet.

This new species is similar to *Palicourea eggersii* (Fig. 11, J), but *Pal. eggersii* can be separated by its shorter stipule lobes, 0.5–0.8 mm long, its flowers that are sessile and grouped in glomerules, its longer calyx limbs, 0.5–0.7 mm long, and its usually four calyx lobes, corolla lobes, and stamens; additionally, *Pal. eggersii* has on average smaller leaf blades, 4–11 × 1–3.5 cm. *Palicourea meieri* is also similar in general aspect to *Pal. cuspidata* (Bredem. ex Schult.) C. M. Taylor; however, *Pal. cuspidata* can be recognized by its leaves with the tertiary venation rather sparsely developed and the quaternary venation sparsely or not at all visible, its rather broadly triangular stipule lobes, and its larger didymous fruits, 3–4 × 5–6 mm, with the pyrenes subglobose and smooth abaxially. *Palicourea meieri* is also similar to *Pal. locellata*; their distinctions are outlined in the discussion of *Pal. locellata*, which was presented previously in this article.

Paratypes. VENEZUELA. **Aragua:** ca. El Loro, 7 km San Casimiro subiendo por El Casupal, Serranía de Golfo Triste, *A. Narváez & L. Cortez 331* (MO), *A. Narváez, W. Meier, C. Bohn, S. Ploeger & O. Kunert 425* (MO); Fila Paloma, 14–16 km S Las Tejerías rd. Tiara, *J. A. Steyermark & C. Steyermark 110015* (MO). **Aragua/Miranda Border:** alrededores Las Dolores, S Loma de Hierro, área Las Mercedes, *W. Meier, O. Kunert & M. Speckmaier 4455* (MO). **Carabobo:** distr. Montalbán, N Montalbán, vertiente S Cumbre Paragüito, cabeceras Río Montero, arriba laguna Ranchería, *W. Meier, C. Bohn & O. Kunert 5110* (MO). **Distrito Federal:** vertiente N, arriba Naiguatá, quebrada del río Camurí Grande, *W. Meier, J. Matute, J. Beck & M. Kindermann 2301* (MO). **Miranda:** S caserío El Palacio de la Providencia, 19 km (dist. aérea) SW Ocumare del Tuy, *A. Narváez, L. Cortéz & O. Kunert 273* (MO). **Sucre:** Peninsula de Paria, Cumbre Las Estrellas, W Manacal, ca. 15 km (by air) NW Irapa, E El Sanche, N El Paujil, *J. A. Steyermark & R. Liesner 120765* (MO).

14. Palicourea minutiflora (Müll. Arg.) C. M. Taylor, comb. nov. Basionym: *Psychotria minutiflora* Müll. Arg., Flora 59: 549, 552. 1876. *Uragoga minutiflora* (Müll. Arg.) Kuntze, Revis. Gen. Pl. 2: 961. 1891. TYPE: Brazil. Bahia: s. loc., s.d., *J. S. Blanchet 3982* (lectotype, designated here, G [barcode] G00300574, G [bc] G00300574 as image; isolectotypes, K [bc] K000014340 n.v., K [bc] K000014340 as image, MO-124232).

Psychotria riedeliana Müll. Arg., Flora 58: 548, 551. 1876, syn. nov. *Uragoga detoniana* Kuntze, Revis. Gen. Pl. 2: 955. 1891, replacement name, not *Uragoga riedeliana* (Müll. Arg.) Kuntze (1891), which is based on *Rudgea riedeliana* Müll. Arg., 1876. TYPE: Brazil. Bahia: Castelnuovo [Ilhéus, Castelo Novo], s.d., *L. Riedel 642* (holotype, G [barcode] G0030075, G [bc] G0030075 as image; isotypes, B† n.v., B† as photo F neg. 489 as image, BR [bc] BR00000532613, BR [bc] BR00000532613 as image, K [bc] K000014341 n.v., K [bc] K000014341 as image).

Habitat and distribution. This species is known from humid Atlantic forest vegetation at 600–960 m in eastern Brazil (Bahia).

Discussion. *Palicourea minutiflora* is characterized by the combination of its long but proportionally rather narrow leaves that usually dry to a brownish green color; its pyramidal inflorescences with the basalmost pair of secondary axes not markedly longer than the other secondary axes, and the numerous flowers rather closely grouped; its small corollas (with tubes ca. 1.5 mm long and lobes ca. 1 mm long); and its fruits with two pyrenes. Descriptions of this species were presented by Müller (1881: 293, as *Psychotria riedeliana*, and 1881: 299, as *Psy.*

minutiflora). Müller distinguished his two species by the insertion of the stamens, in the middle to upper part of the corolla tube in *Psy. riedeliana* versus near the mouth of the corolla tube in *Psy. minutiflora* (Müller, 1881: 272). However, where the stamens are inserted varies by morph in distylous species of *Palicourea*, so this character is correlated as much (or more) with whether he studied long-styled or short-styled flowers than with differences among species. Additionally, the flowers of this species are very small, and Müller noted that a small change in the amount of shrinkage in the corolla as it dries can also produce the difference in stamen insertion. No consistent differences in the level of stamen insertion have been seen in the few flowers studied, and no other distinctions are evident between *Psy. riedeliana* and *Psy. minutiflora*. Therefore, these names are here considered to apply to the same species. These names were published simultaneously and have not previously been synonymized. The name *Psy. riedeliana* does not seem to have been used since its publication, while the name *Psy. minutiflora* has been annotated on specimens and therefore is chosen here for this species. Additionally, the name *Psy. riedeliana* has been confused with the name *Mapouria riedeliana* Müll. Arg., which applies to a very different species, so using the name *Psy. minutiflora* avoids this confusion. *Palicourea minutiflora* is similar to *Pal. mamillaris*; *Pal. mamillaris* can be recognized by its larger inflorescences with longer secondary axes, its shorter corollas, and its smaller fruits, as detailed in the above Key to Species.

Two unnumbered syntype collections from Bahia were cited in the original description of *Psychotria minutiflora*, one collected by Blanchet and one by du Pasquier. There are corresponding specimens at G in Müller's herbarium of each of these. The Blanchet specimen at G has an illegible collection number, with the first three numbers apparently "398"; specimens labeled as *Blanchet 3982* were sent to K and MO as *Psy. minutiflora*, thus *3982* is presumed to be the type collection number. Only one specimen of the du Pasquier collection has been seen (G [unnumbered], G [unnumbered] as photo F. neg. 25807 at MO-1695279), but there are at least three duplicates of the Blanchet collection and it is here chosen as the lectotype.

Only one collection was cited in the protologue of *Psychotria riedeliana*, and there is one specimen of this in Müller's herbarium at G that was annotated by him with this name. This specimen is fragmentary and lacks some of the characters described for this species (Müller, 1881), so he must also have seen another duplicate of this collection. However, what other specimen he studied and took material from is unknown. It seems likely that Müller did use the specimen in his herbarium as his main reference material; therefore, the duplicate of *Riedel 642* at G is considered the holotype of this name, at least until a more complete specimen annotated by Müller is located.

15. Palicourea obconica (Müll. Arg.) C. M. Taylor, comb. nov. Basionym: *Psychotria obconica* Müll. Arg., Flora 59: 550, 553. 1876. *Uragoga obconica* (Müll. Arg.) Kuntze, Revis. Gen. Pl. 2: 961. 1891. TYPE: Brazil. Amazonas: prope San Gabriel de Cachoeira [São Gabriel de Cachoeira], ad Rio Negro, Jan.–Aug. 1852, *R. Spruce 2036* [sic; *2086*] (lectotype, designated here, M [barcode] M0189149 n.v., M [bc] M0189149 as image, M [bc] M0189149 as photo F neg. 6093 at MO-1695290; isolectotypes, BM [bc] BM000624155, BM [bc] BM000624155 as image, G [bc] G00437023, G [bc] G00437023 as image, GH [bc] GH00232887, GH [bc] GH00232887 as image, MO-1613061, NY [bc] NY00132752).

Habitat and distribution. This species is known from humid lowland vegetation at ca. 120 m in northern Brazil (Amazonas) and adjacent southeastern Colombia (Guainía).

Discussion. *Palicourea obconica* is characterized by the combination of its shiny leaves with well-developed intersecondary veins that extend to unite with the secondary veins (i.e., rather than reticulating); its distinctive racemiform inflorescences with the flowers borne in congested groups of five to seven on short secondary axes and the bracts shorter than the flowers; and its unusual obovoid, apparently corky fruits that are 6–8 × 5–6 mm and truncate at the top. This species is poorly documented, and its flowers have not been seen. *Palicourea obconica* is similar to *Pal. soejartoi* of northwestern Colombia, but *Pal. soejartoi* can be recognized by its distinctive fibrous bracts and its fleshy fruits that are rounded at the top.

The single collection of *Psychotria obconica* that was known when this species was described was cited in the protologue of this name (Müller, 1876: 553) as *Spruce 2036*. However, this single specimen was later cited in Müller's floristic treatment (Müller, 1881: 308) under a different number, *Spruce 2086*, without any comment. Two duplicate specimens of *Spruce 2086* are deposited at G where Müller worked, and one is deposited at M in Martius's Brazil flora project

collection. Each of the specimens at G was annotated by Müller and is incomplete: each of these specimens has pieces of stems with well-developed leaves and several loose fruits in a packet. The specimen deposited at M was also annotated as *Psy. obconica* by Müller and is complete: it has a stem with leaves and a complete infructescence with fruits. Thus it appears that all three of these specimens were studied by Müller for the description of *Psy. obconica*, and no single specimen can be identified as a holotype. Only the M specimen has an infructescence, which was described in the protologue by Müller; therefore, this specimen is here chosen as the lectotype. The original labels of *Spruce 2086* were annotated with the name "Psychotria turbinata" in Spruce's handwriting, but this name has not been published.

16. Palicourea octocuspis (Müll. Arg.) C. M. Taylor, comb. nov. Basionym: *Psychotria octocuspis* Müll. Arg., Flora 59: 548, 551. 1876. *Uragoga octocuspis* (Müll. Arg.) Kuntze, Revis. Gen. Pl. 2: 961. 1891. TYPE: Brazil. Bahia: Ilheos [Ilhéus], s.d., *M. A. P. Wied-Neuwied s.n.* (lectotype, designated here, BR [barcode] BR00000659001 n.v., BR [bc] BR00000659001 as image; isolectotypes, BR [bc] BR00000658936 n.v., BR [bc] BR00000658936 as image, BR [bc] BR00000659034 n.v., BR [bc] BR00000659034 as image, BR [bc] BR00000659067 n.v., BR [bc] BR00000659067 as image, BR [bc] BR0000-0825762 n.v., BR [bc] BR00000825762 as image).

Psychotria stellaris Müll. Arg., Flora 59: 547, 552. 1876, syn. nov. *Uragoga stellaris* (Müll. Arg.) Kuntze, Revis. Gen. Pl. 2: 962. 1891. TYPE: Brazil. Bahia, s.d., *J. S. Blanchet 1507* (lectotype, designated here, G [barcode] G0030431, G [bc] G0030431 as image).

Psychotria schottiana Müll. Arg., Flora 59: 547, 552. 1876, syn. nov. *Uragoga schottiana* (Müll. Arg.) Kuntze, Revis. Gen. Pl. 2: 962. 1891. TYPE: Brazil. Rio de Janeiro: Serra do Tinguá, s.d., *G. Scheuch 846* (lectotype, designated here, K [barcode] K000015524 n.v., K [bc] K000015524 as image; isolectotype, K [bc] K000015525 n.v., K [bc] K000015525 as image).

Psychotria vittoriensis Müll. Arg., Flora 59: 548, 551. 1876, syn. nov. *Uragoga vittoriensis* (Müll. Arg.) Kuntze, Revis. Gen. Pl. 2: 963. 1891. TYPE: Brazil. Bahia–Espírito Santo: inter Vittoria & Bahia, s.d., *F. Sellow s.n.* (holotype, G [barcode] G00300488, G [bc] G00300488 as image; isotype, B† n.v., B† as photo F neg. 491 at MO-1695426).

Habitat and distribution. This species is known from humid Atlantic forest vegetation at 10–600 m, in eastern Brazil from Rio de Janeiro to Bahia and also in wet forest in French Guiana.

Discussion. *Palicourea octocuspis* is characterized by the combination of its stipules with truncate sheaths and unusual lobes that are each deeply divided into two to five well-developed linear segments; its leaf blades that are acute to rather shortly acuminate at the apex; its pyramidal inflorescences borne on generally well-developed peduncles; its rather small corollas (with tubes ca. 3 mm long and lobes ca. 1.8 mm long) that have well-developed linear medial appendages on the abaxial surfaces of the lobes; and its fruits with two pyrenes. The stipule lobes are ligulate and not particularly narrow in the basal portion, and are inserted well below the top of the sheath portion. The basal portions of the lobes are much shorter than the upper segmented or divided portions, which are regularly to irregularly pectinate with the segments often spreading to produce a fanlike array. Descriptions of this species were presented by Müller (1881: 291–293, as *Psychotria schottiana*, *Psy. stellaris*, *Psy. vittoriensis*, and *Psy. octocuspis*). There is notable variation in pubescence within *Pal. octocuspis* as circumscribed here, from glabrescent to strigillose or densely hirtellous, but this variation is not correlated with geographic distribution or other morphological features. Several collections from French Guiana are included provisionally here in *Pal. octocuspis*; these plants may represent a separate species, but based on the specimens available now they cannot be separated from the Brazilian plants. *Palicourea octocuspis* is similar to *Pal. fissistipula*; for details of their separation see the discussion above of *Pal. fissistipula*, which was presented previously in this article.

Psychotria fissistipula, *Psy. stellaris*, *Psy. schottiana*, *Psy. vittoriensis*, and *Psy. octocuspis* were separated by Müller (1881: 271–272) based on the number and arrangement of the divisions of the stipule lobes along with the form of the corolla. He diagnosed *Psy. octocuspis* by having stipule lobes divided into two to three generally equal segments, and *Psy. vittoriensis* by having stipule lobes that are divided into two to three unequal segments that are "lanceolato-subulatae" (Müller, 1881: 272). He also separated *Psy. stellaris* and *Psy. schottiana* based on their stipule lobes, which he described as unequally divided into three to four "subulato-laninuligerae" lobes (Müller, 1881: 272). However, the number, size, and shape of the segments of the stipule lobes appear to vary continuously, and three distinct groups cannot be separated among these plants using these characters. Müller further separated *Psy. schottiana* based on its corollas with the tube and lobes about equal in length, in contrast to the corolla lobes 2 to

2.5 times shorter than the corolla tube in *Psy. stellaris*. However, the flowers on the type material seen of *Psy. schottiana* appear to be immature. The corolla tube is normally less well developed than the lobes in general in flower buds of *Palicourea*, and the tube portion elongates markedly just before anthesis. This means that corollas in bud cannot be accurately compared to mature corollas in terms of size. The fully developed corollas seen of this group of plants all have the lobes about half as long as the tube, and are borne on plants with various stipule forms. Thus, these four names cannot be separated morphologically and are synonymized here. These names were all published simultaneously and have not been synonymized previously. The name *Psy. stellaris* Müll. Arg. was accepted by Taylor (2010), but no synonyms were cited there. The name *Psy. octocuspis* has been used more often than the others (J. Jardim, pers. comm.) and is here formally chosen for this species. The separation of *Pal. fissistipula* from *Pal. octocuspis* and also the status of the names synonymized here under both of these species do deserve further study, which should include field observations.

Two collections were cited in the protologue of *Psychotria octocuspis*, an unnumbered collection by Sellow and an unnumbered collection by Prince Neuwied (i.e., M. A. P. Wied-Neuwied). Two fragmentary collections attributed to Sellow are labeled with this name. One is deposited at G and has no collection number and an annotation as *Psy. octocuspis* by Müller. The other is deposited at F, along with a photograph of a specimen labeled *Psy. octocuspis* and *Sellow 220* that was once deposited at B and has now been destroyed. Neither of these Sellow specimens is adequate to fully clarify the identity of *Psy. octocuspis*. There are several good Wied-Neuwied specimens among the specimens from the Martius herbarium at BR, which clearly represent *Pal. octocuspis*. Therefore, this collection is chosen as the type of this name, and a good specimen from this set at BR is chosen as the lectotype.

Three collections were cited in the protologue of *Psychotria stellaris*, *Blanchet 1507* from Bahia, an unnumbered Riedel collection from Rio de Janeiro, and an unnumbered Sellow collection from Bahia. In Müller's herbarium at G three specimens are mounted on a single sheet (G [barcode] 0030431) and identified by Müller as *Psy. stellaris*: a fragmentary unnumbered Sellow collection, a fragmentary Riedel collection collected "inter Campos et Vittoria," and a complete specimen labeled as *Blanchet 1507*. The Sellow collection that was catalogued at B as a type of *Psy. stellaris* has now been destroyed (B† n.v., B† as photo F neg. 492 at MO-1695356). This specimen was labeled *Sellow 375*, and this number is therefore here presumed to be the collection number of this syntype. The Riedel specimens catalogued at F and BR as types of *Psy. stellaris* are labeled as *Riedel 363* with a collection date of December 1823, and this number and this date are therefore presumed here to be the collection number and collection date of this syntype. The complete specimen of *Blanchet 1507* that is deposited in Müller's herbarium and was annotated by him as *Psy. stellaris* is here designated as the lectotype of this name.

Three collections from the same locality were cited in the protologue of *Psychotria schottiana*, *Scheuch 846* (i.e., G. Scheuch, Barão de Capanema), *Scheuch 5312*, and an unnumbered collection of Schott's. Duplicates of all three of these collections have been located in various herbaria. Only the Schott collection is deposited in Müller's herbarium at G, and this specimen has very young flower buds that do not show well the abaxial corolla lobe appendages that Müller used to diagnose *Psy. schottiana*. However, this corolla character is evident in both of the two Scheuch syntype collections. The specimen of *Scheuch 846* at K that is mounted on the same sheet as *Miers 4122* has the best material and is here designated as the lectotype of this name.

One unnumbered Sellow collection was cited in the protologue of *Psychotria vittoriensis*. One such specimen has been seen in Müller's herbarium at G. This specimen was annotated by him with this name and is presumed here to be the holotype of this name.

17. Palicourea racemosa (Aubl.) Borhidi, Acta Bot. Hung. 53(3–4): 247. 2011. *Nonatelia racemosa* Aubl., Hist. Pl. Guiane 1: 187, tab. 72. 1775. *Oribasia racemosa* (Aubl.) J. F. Gmel., Syst. Nat. 367. 1791, nom. illeg. superfl. *Psychotria racemosa* (Aubl.) Raeusch., Nomencl. Bot., ed. 3, 56. 1797, hom. illeg., not *Psychotria racemosa* Rich., 1792. *Uragoga racemosa* (Aubl.) Kuntze, Revis. Gen. Pl. 2: 962. 1891. TYPE: French Guiana. In sylvis teratorii Orapu, s.d., *J. B. C. F. Aublet s.n.* (lectotype, designated by Lanjouw & Uttien [1940: 154], P-JJR 8:271C n.v.).

Psychotria racemosa Rich., Actes Soc. Hist. Nat. Paris 1: 107. 1792. TYPE: French Guiana. s. loc., s.d., *L. C. Richard s.n.* (neotype, designated by Kirkbride [1997: 370], P n.v.).

Nonatelia panamensis DC., Prodr. 5: 478. 1830. TYPE: Panama. s. loc., s.d., *T. Haenke s.n.* (holotype, PR n.v.).

Psychotria longistipula Benth., J. Bot. (Hooker) 3: 227. 1841. TYPE: Brazil. Amazonas: Rio Negro, *R.*

Schomburgk 945 (holotype, K [barcode] K000174266 n.v., K [bc] K000174266 as image).

Psychotria quinquecuspis Müll. Arg., Flora 59: 549, 552. 1876. TYPE: Brazil. Minas Gerais: Lagoa Santa, s.d., *J. E. B. Warming s.n.* (holotype, G [barcode] G00300406, G [bc] G00300406 as image; isotype, C n.v., C as photo F neg. 22848 at MO-1695323).

Habitat and distribution. This species is known from wet forest at 0–700 m and is widely distributed from southern Mexico to Colombia, Trinidad, the Guianas, and south from there to Bolivia and southeastern Brazil.

Discussion. *Palicourea racemosa* is frequently collected and is characterized by its stipules with truncate sheaths and narrow, well-developed lobes (5–18 mm long), its pedunculate, hirtellous or pilosulous inflorescences with the branched portion short and pyramidal and the axes regularly dichasial, its generally small corollas (with tubes 1.5–3 mm long and lobes 1–1.5 mm long) that have apparently straight tubes and well-developed slender medial appendages on the abaxial surfaces of the lobes, its five stigmas, and its fruits with five pyrenes. Descriptions of this species were presented (as *Psychotria racemosa*) by Taylor (1997b: 629), Taylor (2001b: 2271), Taylor et al. (2004: 755), Taylor (2007: 407), and Lorence et al. (2012: 235). *Palicourea racemosa* is one of the most commonly collected and widely distributed species of *Palicourea* and shows relatively little morphological variation across its geographic range. Plants of Mexico and Central America do have on average the largest leaves and inflorescences, while those of the Guianas and Brazil have the smallest. However, the plants within any given region show most or all of the full range of variation found within the species across its range, and no clear infraspecific groups can be distinguished based on morphology. In fruit *Pal. racemosa* is easily identifiable, but in flower it is frequently not recognized. Several other species of *Palicourea* also have fruits with five pyrenes, and most of them are members of *Palicourea* sect. *Nonatelia*. The other species of this section with fruits with five pyrenes can be separated by their spiciform to narrowly triangular inflorescences, and the other lowland species of *Palicourea* with fruits with five pyrenes have broadly triangular to rounded stipule lobes. *Palicourea racemosa* has sometimes been confused with *Psy. deflexa* and *Psy. venulosa*, which also have well-developed tertiary leaf venation, regularly dichasial inflorescence axes, and small flowers; however, these last two species can be recognized by their generally shorter stipule lobes, 1.5–8 mm long, their generally narrowly pyramidal to cylindrical inflorescences, their corolla lobes that are smooth abaxially, and their fruits with two pyrenes.

Bremekamp (1934: 299) reported that the flowers of *Palicourea racemosa* are isostylous and its stamens are consistently inserted near the base of the corolla tube. As discussed in more detail above, in the introductory portion of this article, mature flowers of this species are poorly documented, but all the flowers studied here are similar. These have the anthers partially exserted and the apparent stigmatic portion of the style positioned at the same height as the anthers, with its tip held just above the anthers. There does appear to be some variation in the form of the stigmatic or top portion of the style, with the lobing ranging from short to deep, but this character is difficult to evaluate on herbarium specimens. Thus *Pal. racemosa* does appear to be isostylous; however, this possible variation in stigma form along with Bremekamp's observation of stamens inserted near the base of the corolla in some flowers suggests there may actually be two flower forms. Field observations will be needed to understand the floral biology of this species.

The name *Psychotria racemosa* (Aubl.) Raeusch., based on *Nonatelia racemosa* Aubl., was long used for this species. However, Kirkbride (1997) noted that the name *Psy. racemosa* Rich. is an older and nomenclaturally separate name for this species, and is its correct name when this species is classified in *Psychotria*. Aublet's name *N. racemosa* therefore cannnot be transferred into *Psychotria* because its epithet was previously used. *Nonatelia racemosa* Aubl. is the oldest name overall for this species, however, and therefore is here transferred to *Palicourea*. Kirkbride discussed this nomenclatural situation and concluded by designating a neotype for the name *Psy. racemosa* Rich. (Kirkbride, 1997: 371–372, figs. 7, 8). Delprete (2015) clarified the typification of *N. racemosa* and reported the probable collection date of the type specimen as March 1764.

The identity of *Nonatelia panamensis* DC. is not entirely clear. The original description of this species agrees with *Psychotria racemosa*, and Oersted (1852) considered these Panamanian plants probably only a variety of *Psy. racemosa*. The type of *N. panamensis* has not been seen, but it is provisionally synonymized with *Palicourea racemosa* here following Oersted (1852) and Lorence (1999). Certainly no other species with the characters given in the protologue of *N. panamensis* are documented from Panama by current floristic studies. The name *N. panamensis* was overlooked by Lorence et al. (2012).

18. Palicourea soejartoi (C. M. Taylor) C. M. Taylor, comb. nov. Basionym: *Psychotria soejartoi* C. M.

Taylor, Novon 14(4): 506, fig. 3A. 2004. TYPE: Colombia. Antioquia: mpio. Anorí, correg. Providencia, Valle Río Anorí, entre Dos Bocas & Anorí, Buenos Aires, above bridge betw. Providencia & Anorí, ca. 4 km upriver, 400–900 m, 6–12 Sep. 1973, *D. D. Soejarto, R. Fonnegra, P. Havens & J. White 4318* (holotype, MO-4030419; isotype, F-1809850).

Habitat and distribution. This species is known from wet forest in eastern Panama and northwestern Colombia at 0–900 m, apparently at least sometimes on sandstone substrates.

Discussion. *Palicourea soejartoi* is characterized by the combination of its medium-sized to rather large leaf blades, 10–25 × 3.8–11 cm; its short spiciform inflorescences with the flowers and fruits borne in sessile glomerules along the primary axis, and subtended by distinctive fibrous bracts; its rather large corollas (with tubes 4–9 mm long) that have lobes that are smooth abaxially; and its fruits with two pyrenes that are abaxially broadly angled with four or five smooth sides. Descriptions of this species were presented (as *Psychotria soejartoi*) by Taylor (2004b: 506–507, fig. 3A) and Lorence et al. (2012: 238, as *Psy. soejartoi*). In general aspect *Pal. soejartoi* resembles *Pal. stenostachya* of the Amazon basin and *Pal. tsakiana* of Costa Rica; however, these last two species can be separated by their inflorescences with reduced bracts and the secondary axes generally developed at least tardily, along with their fruits with five abaxially ridged pyrenes.

19. Palicourea stenostachya (Standl.) C. M. Taylor, comb. nov. Basionym: *Psychotria stenostachya* Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 8(3): 207. 1930. TYPE: Peru. Loreto: San Antonio on Rio Itaya, 110 m, 18 Sep. 1929, *E. P. Killip & A. C. Smith 29294* (holotype, F-607496 n.v., F-607496 as image; isotypes, NY [barcode] NY00132834 n.v., NY [bc] NY00132834 as image, US-1462682 n.v., US-1462682 as image). Figure 2G, H.

Habitat and distribution. This species is known from wet primary and secondary forest, in both nonflooded and occasionally seasonally flooded areas, in the north-central to western Amazon basin at 100–900 m in southern Colombia, Ecuador, Peru, and Brazil, in the southern Orinoco drainage in Brazil and Venezuela, and locally up to 1900 m in Amazonian central Peru.

Discussion. *Palicourea stenostachya* is characterized by the combination of its stipules with well-developed truncate sheaths and lobes, its spiciform or narrowly cylindrical to narrowly pyramidal inflorescences, its flowers that are sessile in small congested to dichasial groups, its rather short calyx limbs (ca. 0.5 mm long), its somewhat small tubular to usually funnelform corollas (with tubes 4.5–7 mm long and lobes 2–3 mm long) that are bent and gibbous at the base and have well-developed linear medial appendages (0.3–1 mm long) on the abaxial surfaces of the lobes, its anthers and stigmas that are both shortly exserted, its 5-lobed stigma and disk, and its fruits with five pyrenes that are abaxially ridged. The inflorescences are initially spiciform and cylindrical, but sometimes change their form during fruit development when the secondary axes develop further and change the inflorescence profile to narrowly pyramidal. The dried specimens sometimes are green but usually have a distinctive orange-brown color. A description was presented by Taylor (1997b: 630; as *Psychotria stenostachya*). *Palicourea stenostachya* is similar to *Pal. subfusca*; for their distinctions see the discussion below of *Pal. subfusca*, which is treated later in this article.

Palicourea stenostachya is one of the most commonly collected *Palicourea* species in the western Amazon basin. It shows some variation in size of the leaf blades, length of the inflorescences, and length of the secondary axes of the infructescences, but the variation in these individual features is not correlated with any other features or with geographic distribution. *Palicourea stenostachya* is documented by only a few collections from the southernmost Orinoco drainage in northern Brazil and southern Venezuela; the identity of these Venezuelan plants was not entirely clear until now, and this species was not reported by Taylor et al. (2004).

20. Palicourea subfusca (Müll. Arg.) C. M. Taylor, comb. nov. Basionym: *Psychotria subfusca* Müll. Arg., Fl. Bras. 6(5): 297. 1881. TYPE: Brazil. Amazonas: Alto Amazonas, Rio Negro, s.d., *C. Martius s.n.* (holotype, M-189083 n.v., M-189083 as image, M-189083 as photo F neg. 6110 at MO-1695363; isotype, G [barcode] G00300442, G [bc] G00300442 as image).

Psychotria tessmannii Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 4(8): 341. 1929, syn. nov. TYPE: Peru. Ucayali: stromgebiet des Ucayali von 10°S bis zur Mündung, 1923, *G. Tessmann 3014* (holotype, S-05-1142 n.v., S-05-1142 as image; isotypes, F-588534 n.v., F-588534 as image, F-789259 n.v., F-789259 as image).

Habitat and distribution. This species is known from primary and secondary wet forest at 100–700 m, often in swamps along rivers and seasonally flooded areas, in the western to central Amazon basin in Ecuador, Peru, Bolivia, and Brazil.

Discussion. *Palicourea subfusca* is characterized by the combination of its stipules with well-developed truncate sheaths and narrow lobes, its spiciform to narrowly cylindrical or narrowly pyramidal inflorescences with the flowers sessile in small congested to dichasial groups, its rather small corollas (with tubes 2.5–6 mm long and lobes 1–3 mm long) that are tubular to usually funnelform and have a well-developed linear medial appendage (0.3–1 mm long) on the abaxial surfaces of the lobes, its anthers and stigmas that are both exserted, its 5-lobed stigma and disk, and its fruits with five pyrenes that vary from smooth and rounded to angled or obtusely ridged on their abaxial (dorsal) surfaces. The inflorescences typically change their form during flowering and fruiting, which has led to some confusion about the identity of this species. Initially the inflorescences are spiciform or narrowly cylindrical with the flower buds sessile in small glomerules on apparently unbranched axes, but as the flowers develop, the secondary axes and then the higher-order axes elongate. Eventually the inflorescences are branched to as many as three orders, so the flowers are borne in subcapitate groups or even are all separated from each other in dichasial cymes. These inflorescence axes then continue to elongate as the fruits develop, so the inflorescence does not change in length and may vary from 1.5 cm wide at its widest point when the flowers are at anthesis, to more than three times that wide, up to 5 cm, when the fruits are maturing. Specimens of *Psychotria subfusca* very often dry with a dark gray or blackened color. A description of this species was presented by Müller (1881: 297, as *Psy. subfusca*).

Palicourea subfusca is similar to *Pal. stenostachya*, in particular in the spiciform inflorescences, small corollas with well-developed abaxial appendages, and fruits with five pyrenes, and these two species are both frequently collected in the western Amazon basin. *Palicourea stenostachya* differs from *Pal. subfusca* in its strigillose to velutinous stem pubescence, and its inflorescences that remain spiciform with their flowers borne directly from the primary axes or on very short secondary axes, up to 5 mm long. Plants of these two species with immature fruits are often difficult to identify. *Palicourea stenostachya* has been more commonly collected than *Pal. subfusca*.

The identity of the name *Psychotria subfusca* has been unclear until recently. This name was based on a single collection with immature fruits that are apparently not all completely developed, so there are variously one or two immature pyrenes. The name *Psy. subfusca* seems not to have been taken up since it was published, and this species was thought to be restricted to a small part of Brazilian Amazonia that is still not well known. However, recent explorations in the western Amazon basin have documented this species well enough that the type of *Psy. subfusca* can be matched to it and the identity of this name clarified.

One unnumbered Martius collection was cited in the protologue of *Psychotria subfusca*, which thus constitutes the type collection. There is a duplicate that is morphologically complete of this collection in Martius's herbarium at M, which was annotated by Müller. There is also an incomplete duplicate in Müller's herbarium at G, which was also annotated by him. The specimen at G does not have all the characters Müller described for this species, so presumably the complete specimen at M was the material on which the description was based and this M specimen is here considered the holotype.

Standley cited two specimens in his original description of *Psychotria tessmannii*, *Tessmann 3014* and *Spruce 4383*, and explicitly designated the specimen deposited at S of *Tessmann 3014* as the type of this name.

No material of the name *Psychotria opima* Standl. has been found, but its description suggests that this is similar to *Palicourea subfusca* and perhaps synonymous. This *Psychotria* name is discussed in more detail in the Problematic Names section, which is presented later in this article.

21. Palicourea tacarcunensis (Dwyer) C. M. Taylor, comb. nov. Basionym: *Psychotria tacaracunensis* Dwyer, Ann. Missouri Bot. Gard. 67(2): 431. 1980. TYPE: Panama–Colombia Border. Darién/Chocó: top of W peak Cerro Tacarcuna massif, 1800–1850 m, 28 Jan. 1975, *A. Gentry & S. Mori 13974* (holotype, MO-2242943).

Habitat and distribution. This species is found in montane elfin forest at 1650–1850 m on Cerro Tacarcuna, on the Panama–Colombia border.

Discussion. *Palicourea tacarcunensis* is characterized by the combination of its somewhat small leaf blades (4–11.5 × 1–3.5 cm); its stipules that have truncate sheaths and short, narrow lobes; its rather small pyramidal inflorescences with the flowers sessile in small groups or short dichasial cymes; its

short calyx limbs, 0.8–1 mm long; its medium-sized somewhat didymous fruits (4 × 5–5.5 mm) with the pyrenes smooth abaxially; and its brown or reddish brown drying color. *Palicourea tacarcunensis* is not well documented, and its flowers have not yet been collected. This species is confirmed only from Cerro Tacarcuna on the border of Colombia and Panama. This mountain is the highest point on the Serranía de Darién, which is a poorly explored region. Some additional specimens have been identified as *Psychotria tacarcunensis*, but these identifications have not been confirmed in this study. A description of *Pal. tacarcunensis* was presented by Lorence et al. (2012: 239; as *Psy. tacarcunensis*).

Palicourea tacarcunensis is very similar to *Pal. amita* of the Andes in Venezuela and eastern Colombia, which can be recognized by its shorter calyx limbs, 0.5–0.7 mm long, and its separate geographic range. The plants described as *Pal. tacarcunensis* may represent an allopatric sister species of *Pal. amita* or an isolated population of that Andean species. The status of *Pal. tacarcunensis* cannot be evaluated further until it is better known.

22. Palicourea topoensis C. M. Taylor, sp. nov. TYPE: Ecuador. Napo: Parque Nac. Sumaco–Galeras, S slope Sumaco volcano, 00°37′S, 77°35′W, 1600 m, 15 Oct. 2005, *J. Homeier & M. A. Chinchero 1879* (holotype, MO-6136935; isotypes, GOET n.v., QCA n.v.). Figure 1A–D.

Diagnosis. *Palicourea topoensis* C. M. Taylor is distinguished from *Pal. amita* by its broader leaves, its shorter stipule sheaths, its shorter calyx limbs, its corolla lobes with abaxial appendages, and its larger fruits with the pyrenes abaxially smooth.

Shrubs, flowering at 1 m tall, to 4 m tall; stems weakly quadrangular, puberulous to glabrous. Leaves opposite; blades elliptic to broadly elliptic, 3.5–13.5 × 1.5–6 cm, at base acute to obtuse, at apex acuminate with tips 0.5–2 cm, drying papery, adaxially glabrous, abaxially glabrous or sometimes strigillose along sides of costa; secondary veins 6 to 8 pairs, extending to near margins then reticulating or sometimes distalmost veins looping to interconnect, without intersecondary veins or with 1(2) intersecondary vein(s) present between some pairs of secondary veins, without domatia, adaxially venation plane or costa and sometimes secondary veins sulcate, abaxially costa and secondary veins prominent, tertiary venation prominulous, and quaternary venation sparsely visible and plane to prominulous; margins thinly cartilaginous; petioles 0.5–1.5 cm, glabrous; stipules persistent, united around stem, glabrous to strigillose, sheath 0.8–1.2 mm, truncate, smooth or with short ridges extending below lobes, lobes 2 on each interpetiolar side, narrowly triangular, 0.8–1.5 mm, inserted at or just below top of sheath, acute, apparently glandular in upper half, at least sometimes adaxially with a triangular gland ca. half as long as lobe and inserted near base of lobe, old stipules with sheath often becoming indurate and sometimes fragmenting and lobes becoming indurate and sometimes deciduous by fragmentation. Inflorescences terminal, paniculiform, glabrous to puberulous or strigillose, apparently green; peduncle 1.5–5 cm; branched portion pyramidal, 3–4.5 × 1.5–6 cm, branched to 3 to 4 orders; secondary veins 4 or 5 pairs, opposite or sometimes irregularly arranged; bracts subtending secondary axes triangular, 0.5–1.5 mm, acute, ciliolate, bracts subtending flowers linear to triangular, 0.3–0.5 mm. Flowers sessile, in groups of 2 to 3 or borne separately in dichasial cymes, whether distylous or isostylous unknown; hypanthium ellipsoid to obconic, 0.5–0.8 mm, glabrous; calyx limb 0.3–0.5 mm, glabrous to puberulous, lobed shallowly or for up to half its length, lobes 5, broadly triangular to deltate, obtuse to acute; corolla tubular-funnelform, white to yellow, externally glabrous, internally not seen, tube ca. 3.5 mm, straight at base and along its length, lobes 5, narrowly triangular, 1.5–2 mm, at apex shortly adaxially galeate-hooked, abaxially with linear medial appendage ca. 0.3 mm; anthers ca. 1.5 mm, exserted; stigmas 2, linear, ca. 1 mm, included, positioned near middle of corolla tube; disk 2-lobed. Infructescences similar to inflorescences. Fruits subglobose to weakly didymous, 5–6 × 6–7 mm, glabrous, orange becoming red then black; pyrenes 2, hemispherical, abaxially smooth (mesocarp of fruit sometimes with longitudinal veins that resemble pyrene ridges), adaxially plane with central longitudinal sulcus and basal pore.

Habitat and distribution. This species is known from wet premontane forest at 1050–2090 m in north-central to southern Ecuador, at least sometimes on sandstone substrates; it has been collected in flower in June and August through October, and in fruit February through May and September through November.

Discussion. *Palicourea topoensis* is characterized by the combination of its rather small to medium-sized elliptic leaves with the characteristic venation of *Palicourea* sect. *Nonatelia*, its persistent stipules that are united around the stem with

two narrow lobes on each side, its pyramidal paniculiform inflorescences, its rather small white flowers, and its subglobose fruits with two pyrenes that are smooth abaxially. No pubescence is evident in the corolla throat, but whether the corolla is internally pubescent is unknown. Few flowering collections of this species have been seen and each has only a single mature flower, many of which are not well preserved, so the corollas have not been dissected. All the flowers of *Pal. topoensis* seen are similar to the short-styled form of distylous *Palicourea* species, but whether this species is distylous cannot be determined from the material available. The stigma measurements here are based on flowers on which the corolla has fallen, but the style and stigmas have persisted. *Palicourea topoensis* was first recognized as an undescribed species by Standley, who annotated one fruiting specimen (*Steere & Camp 8260*, F) as "Psychotria topoensis" but never published that name. Standley's species epithet is used here, but this species has been better documented since his work, so a better specimen is here designated as the type and this species is classified in a different genus than Standley proposed.

Palicourea topoensis is similar to *Pal. amita* of montane Venezuela and eastern Colombia; however, *Pal. amita* can be separated by its more narrowly elliptic leaves, generally 1.3–3 cm wide, its larger stipules with the sheath 2–4 mm long, its longer calyx limbs, 0.5–0.7 mm long, its corolla lobes that are smooth abaxially, and its smaller fruits, 4–5 × 4–5 mm, with the pyrenes abaxially ridged.

Paratypes. ECUADOR. **Morona-Santiago:** ridge ascending central Cordillera Cutucú, *W. H. Camp E-1170* (S); 20 km SE San Juan Bosco, *A. Gentry, C. Bonifaz & J. Loor 30965* (MO). **Napo:** cantón Archidona, faldas S Volcán Sumaco, *S. Moritz, S. Trogisch & J. Homeier 243* (GOET n.v., MO), comun. Challua Yacu, *A. Alvarado 99* (MO, QCNE n.v.), *A. Alvarado 185* (MO, QCNE n.v.), rd. Guagua Sumaco–Pacto Sumaco, Km. 5, Wildsumaco Wildlife Sanct., *C. Persson 1335* (MO); comun. El Pacto, 9 km N carr. Hollín–Loreto, *A. Alvarez, A. Zamora & V. Huaraca 1219* (MO, QCNE n.v.), límite Parque Nac. Sumaco, *A. Alvarez, J. Machuca, A. Zamora & V. Huaraca 1884* (MO, QCNE n.v.), sector Guagua Sumaco, *V. Zak & J. Jaramillo 3747* (MO); Reserva Ecol. Antisana, comun. Shamato entrada Km. 21 camino Sardinas–Shamato, *J. L. Clark, E. Narvaez & T. Pauchi 5034* (MO, QCNE n.v.), *J. L. Clark, E. Narvaez & P. Mamallacta 5269* (MO, QCNE n.v.); parroq. Catundo, buffer zone Parque Nac. Sumaco Napo Galeras, comun. Mushullakta, *J. L. Clark & 2011 Alabama in Ecuador Program Participants 12030* (MO, UNA n.v.); carr. Hollín–Loreto, Km. 40, caserío Huamaní y Río Pucuno, *F. Hurtado, R. Rentería & P. Mena 85* (MO, QCNE n.v.), O Caserío de Huamaní, *F. Hurtado, D. Neill & A. Alvarado 177* (MO, QCNE n.v.), Km. 17 ca. Río Hollín, *F. Hurtado & J. Shiguango 1736* (MO, QCNE n.v.), *F. Hurtado & J. Shiguango 1772* (MO, QCNE n.v.); Cordillera Galeras, *S. Moritz, S. Trogisch & J. Homeier 108* (GOET n.v., MO). **Pastaza:** 1 km al E de Topo por carr. entre Baños & Mera, *W. Palacios, D. Neill, M. Baker & J. Zaruma 180* (MO, QCNE n.v.); headwaters Río Tigre which joins Río Pastaza at El Topo, *W. C. Steere & W. H. Camp 8260* (F). **Zamora-Chinchipe:** Parque Nac. Podocarpus, Bombuscaro entrance, *P. Butz 50* (GOET n.v., MO, QCA n.v.); cantón Valladolid, 1–2 km N El Porvenir del Carmen along main trail to Layola, next to Río San Luis, *J. L. Clark, J. R. Bennett, L. Bohs & N. Leon 8999* (MO); Sabanilla, rd. Loja–Zamora, 38 km from Loja, *J. Homeier & F. Werner 4210* (GOET n.v., MO); región Cordillera del Cóndor, cuenca alta Río Nangaritza, sector Las Orquídeas, *W. Quizhpe, C. Chimbo & A. Jiménez 171* (MO; labels printed with variant name spelling "Quishpe").

23. Palicourea tsakiana (C. M. Taylor) C. M. Taylor, comb. nov. Basionym: *Psychotria tsakiana* C. M. Taylor, Novon 21: 146. 2011, replacement name, based on *Rudgea thyrsiflora* Donn. Sm., Bot. Gaz. 61(5): 375. 1916, not *Palicourea thyrsiflora* (Ruiz & Pav.) DC., 1830. TYPE: Costa Rica. Limón: Talamanca, forêts de Tsâki, 200 m, Apr. 1895, *A. Tonduz 9579* (holotype, US-943477; isotypes, BR [barcode] BR0000005326204, BR [bc] BR0000005325887).

Habitat and distribution. This species is known from wet forest at 0–800 m in southern Central America, in eastern Nicaragua, eastern Costa Rica, and western Panama.

Discussion. Palicourea tsakiana is characterized by the combination of its medium-sized leaf blades (15–22 × 5–8.5 cm); its stipules that have a well-developed truncate sheath and narrow lobes; its rather short racemiform inflorescences that are cylindrical or narrowly pyramidal in form, with the branched portion 3–3.5 cm long and the flowers and fruits sessile in small glomerules; its rather small corollas (with tubes 4–5 mm long) that are curved near the base and have well-developed medial appendages on the abaxial surfaces of the lobes; and its fruits with five triangular pyrenes that are abaxially ridged. The inflorescences of *Pal. tsakiana* are somewhat variable in form, from narrowly cylindrical with the secondary axes short or developed and subequal, to narrowly pyramidal with the basalmost secondary axes longer than the uppermost axes. A description of this species was presented by Lorence et al. (2012: 240, as *Psychotria tsakiana*).

Palicourea tsakiana is similar to *Pal. stenostachya* and *Pal. racemosa*. *Palicourea stenostachya* is found in a separate range in Amazonian South America and can be recognized by its longer spiciform inflorescences, with the flower-bearing portion above the peduncle 7–9 cm long. The range of *P. racemosa* includes the Central American area where *Pal. tsakiana* is found; *Pal. racemosa* can be recognized by its pyramidal inflorescences and its smaller corollas (with tubes 1.5–3 mm long) that are apparently straight rather than curved in the tube.

24. Palicourea valerioana (Standl.) C. M. Taylor, comb. nov. Basionym: *Psychotria valerioana* Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 18(4): 1363. 1938. TYPE: Costa Rica. Alajuela: Cerros de San Pedro de San Ramón, 1075 m, June 1926, *A. M. Brenes 4886* (holotype, F-853470).

Habitat and distribution. This species is known from wet forest and cloud forest at 400–1600 m in southern Central America, in Costa Rica, Panama, and also northwestern Colombia (Chocó).

Discussion. *Palicourea valerioana* is characterized by the combination of its medium-sized to rather small leaves; its unusual stipules that have a truncate persistent sheath and one deciduous lobe inserted below the top of the sheath; its short corymbiform to broadly pyramidal inflorescences with the flowers borne in small cymes; its somewhat large corollas (with tubes 4–6 mm long) that have lobes that are abaxially smooth to thickened; and its somewhat large fruits (ca. 5 × 7 mm) with two pyrenes that are abaxially ridged. The stipules of *Pal. valerioana* have a single lobe that is borne medially on the abaxial surface of the sheath, a form that is unique in *Palicourea*. This solitary stipule lobe is usually divided shortly or for up to half its length into two unequal parts, which suggests it may be formed by the fusion of the two stipule lobes that are characteristic of *Palicourea*, rather than by loss of a stipule lobe. The main part of the stipule lobe of *Pal. valerioana* is a narrowly triangular to linear segment that is entire or occasionally bifid and is composed of normal tissue or sometimes apparently glandular at the tip. This main segment usually produces a shorter segment in its upper portion. The shorter segment is linear or more often narrowly ellipsoid, apparently glandular, and deciduous before the longer lobe. These stipules resemble those of some species of *Rudgea* (Zappi, 2003). However, the stipule lobes of *Pal. valerioana* are bifid as in *Palicourea* rather than irregularly divided as in *Rudgea* (Taylor et al., 2015), and molecular sequence data indicate this species is related to other species of *Palicourea* sect. *Nonatelia* (Sedio et al., 2013). The pyrenes of *Pal. valerioana* are smooth to broadly angled when young, then later develop several prominent ridges shortly before they are mature; this species was incorrectly described as having smooth pyrenes by Lorence et al. (2012) based on observation of only immature fruits. The species epithet commemorates the Costa Rican botanist Prof. Juvenal Valerio (1900–1971) and was originally published in the Latinized form "valeriana." However, the nomenclatural rules regarding the Latinization of modern names were changed in the late 20th century, so the correct spelling of this species epithet is now "valerioana" (McNeill et al., 2012). A description of this species was presented by Lorence et al. (2012: 240, as *Psychotria valerioana*).

Palicourea valerioana is similar to *Pal. veracruzensis*, which is found from Mexico through Central America. *Palicourea veracruzensis* also has stipules with a well-developed truncate sheath and the lobes inserted below the margin and deciduous. However, the stipules of *Pal. veracruzensis* consistently have two separate lobes on each interpetiolar side, and these are occasionally bifid or trifid but are not or only occasionally glandular. *Palicourea veracruzensis* can also be recognized by its shorter corollas, with tubes 2–3 mm long, and its leaf blades that are generally rounded to truncate at the base, in contrast to leaf blades that are obtuse to acute at the base in *Pal. valerioana*.

25. Palicourea veracruzensis (Lorence & Dwyer) Borhidi, Acta Bot. Hung. 53(3–4): 248. 2011. *Psychotria veracruzensis* Lorence & Dwyer, Bol. Soc. Bot. México 47: 621, fig. 4. 1987. TYPE: Mexico. Veracruz: mpio. San Andrés Tuxtla, Estación Biol. Tropical "Los Tuxtlas," entre Sontecomapan & Montepío, vereda al Cerro Vigía, 150–250 m, 18 Apr. 1981, *D. Lorence & T. P. Ramamoorthy 3313* (holotype, MEXU n.v.; isotypes, BM n.v., F n.v., MEXU n.v., MO-2887097, UC n.v., XAL n.v.).

Habitat and distribution. This species is known from wet forest at 80–1450 m, from southern Mexico through Costa Rica; it has been collected frequently in Mexico but rather infrequently south of there.

Discussion. *Palicourea veracruzensis* is characterized by the combination of its medium-sized to rather small leaf blades that are rounded to truncate at the base, its stipules with a truncate sheath and two narrow lobes on each side that are inserted below the top of the sheath, its short subcapitate to corymbiform inflorescences with the flowers and fruits borne in small cymes, its rather small corollas (with tubes 2–3 mm long) that have the lobes abaxially thickened but not appendaged, and its fruits with two pyrenes that are abaxially weakly ridged. The stipule lobes are sometimes deciduous, and are entire to bifid or occasionally trifid and apparently sometimes glandular. A description of this species was presented by Lorence et al. (2012: 240–241, as *Psychotria veracruzensis*). *Palicourea veracruzensis* is similar to *Pal. valerioana*, which can be separated by its stipules with a single medial lobe on each interpetiolar side, its leaf blades that are obtuse to acute at the base, and its longer corollas, with tubes 4–6 mm long.

Palicourea veracruzensis is variable morphologically, and two groups of plants are often separable but apparently not completely distinct. One group of plants has a generally green drying color, ovate leaf blades that are broadly rounded along the sides, and congested to subcapitate inflorescences with the axes often becoming thickened as the fruits develop; these plants are found in Mexico and include the type of *Pal. veracruzensis*. The other group of plants has a reddened or reddish brown drying color, narrowly lanceolate or oblanceolate leaves with the lateral margins rather straight, and shortly branched inflorescences that are lax with slender axes; these plants are found from southern Mexico through Costa Rica. However, some plants with leaves that match the first group have inflorescences characteristic of the second group. A distinctive reddened drying color is characteristic of most collections from Honduras, but is also found in some specimens from scattered sites in Mexico and Belize. Both of these generalized forms are represented by the specimens originally included in this species by Lorence and Dwyer (1987).

26. Palicourea woronovii (Standl.) C. M. Taylor, Bruniera & Zappi, Kew Bull. 70(45): 2, fig. 2. 2015. *Rudgea woronovii* Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 7(1): 155. 1930. TYPE: Colombia. Caquetá: ca. Ketuchá, Río Ortegraza, 20 Aug. 1926, *G. Woronow 6064* (holotype, LE n.v.; isotype, F-599983 n.v., F-599983 as image).

Habitat and distribution. This species is known from wet forest at 150–850 m in the northern Amazon basin, in southern Venezuela, southern Colombia, eastern Ecuador, and northeastern Peru.

Discussion. *Palicourea woronovii* is a distinctive species that is characterized by its relatively large, shortly petiolate to subsessile leaf blades (20–30 × 8–12 cm), its well-developed fimbriate-laciniate bilobed stipules with the segments glandular at the tips, its relatively large pyramidal inflorescences with numerous secondary axes and reduced bracts, its small corollas (with tubes ca. 1 mm long and lobes ca. 0.3 mm long), and its rather small white fruits (3.5–4 × 3–4 mm) with the pyrenes abaxially ridged. Plants of *Pal. woronovii* are characteristically rather short (0.5–1 m tall) and unbranched, and they accumulate detritis around the leaf bases and produce adventitious roots that grow into this decaying detritus. In most plants with this "trash bucket" habit, the detritus is accumulated by the bases of the subsessile or sessile leaves. However, in *Pal. woronovii* the detritus is held mainly by the enlarged stipules. Descriptions of this species were presented (as *Rudgea woronovii*) by Steyermark (1974: 1064–1065) and Taylor et al. (2004: 810–811). The illustration of this species presented by Taylor et al. (2004: fig. 617) is generally accurate, except the stipules are depicted inaccurately as triangular. Photos of living plants of this species were presented by Taylor et al. (2015: fig. 2).

Standley noted when he described this species that it appeared to belong to *Palicourea*, except it had the fimbriate emarginate stipule form of *Rudgea*. However, the stipules of *Rudgea* are rounded to truncate, while those of *R. woronovii* are emarginate or bilobed and thus agree with *Palicourea* rather than *Rudgea* (Taylor et al., 2015). *Palicourea woronovii* is provisionally included here in *Palicourea* sect. *Nonatelia*, and its possible other relationships and the characters that support its placement in *Palicourea* sect. *Nonatelia* are discussed in more detail in the introductory portion of this article.

Problematic Names

Psychotria opima Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 11(5): 243. 1936. TYPE: Peru. Loreto: lower Río Napo, 100 m, 1 Aug. 1924, *G. Tessmann 3710* (holotype, B† n.v.; isotype, F-638776 n.v., F-638776 as image).

Discussion. *Psychotria opima* was described based on one specimen that was deposited at B. This specimen has since been destroyed, and apparently it was not documented by a photograph. Several pieces of a leaf and a small part of an inflorescence were removed from the holotype specimen and deposited at F. These fragments are not adequate to determine the identity of this name, however. Based on its description *Psy. opima* is similar to species of *Palicourea* sect. *Nonatelia*, and it was suggested in the protologue to be similar to *Psy. myriantha*, which is included here in this new section as *Palicourea mamillaris*. In particular, *Psy. opima* seems to be similar to *Pal. subfusca*. Its original description did not detail the number of stigmas, ovary locules, or pyrenes per fruit, however, which would help clarify this possible similarity; these characters are not evident on the F specimen.

Psychotria vauthieri Müll. Arg., Fl. Bras. 6(5): 295. 1881. *Uragoga vauthieri* (Müll. Arg.) Kuntze, Revis. Gen. Pl. 2: 963. 1891. TYPE: Brazil. s. loc., s.d., *A.-C. Vauthier s.n.* (holotype, G [barcode] G00300926, G [bc] G00300926 as image).

Discussion. Only one authentic specimen of *Psychotria vauthieri* has been seen, which is deposited at G and was annotated with this name by Müller. This specimen is thus assumed to be the holotype. Its collection locality is unknown, and its species identity is not entirely clear from this specimen. This specimen is incomplete, with one pair of leaves attached to a stem at a node that also has a stipule and an old inflorescence from which corollas have fallen. This specimen generally matches *Palicourea brevicollis*, but the stipule sheath is unusually large for *Pal. brevicollis* and has become stiff or indurate, which has not otherwise been documented in *Pal. brevicollis*. This specimen of *Psy. vauthieri* does appear to belong to *Palicourea* sect. *Nonatelia*, but clarification of the identity of this name (as a distinct species or a synonym) will require better type material. It seems likely that a complete specimen was seen by Müller and will be found at some point. A specimen labeled *Vauthier 96* and deposited at K (K [barcode] K000015526 n.v., K [bc] K000015526 as image) is complete and represents *Pal. brevicollis*, and this specimen may be an isotype, but this cannot be confirmed at present. The name *Psy. vauthieri* does not have priority over the name *Pal. brevicollis*.

Excluded Species

Psychotria cujabensis Schltdl., Linnaea 28(4): 507. 1856 [1857]. *Uragoga cujabensis* (Schltdl.) Kuntze, Revis. Gen. Pl. 2: 960. 1891. TYPE: Brazil. Mato Grosso: near Cujabá, s.d., *J. Lhotzky Fl. exs. no. 19* (holotype, HAL-75848 n.v., HAL-75848 as image; isotype, MO-124399).

Discussion. Müller (1876, 1881) considered *Psychotria cujabensis* to be closely related to two species of *Palicourea* sect. *Nonatelia*, *Pal. brevicollis* and *Pal. myriantha*. The type of *Psy. cujabensis* has stipules generally similar in form to those of *Palicourea* sect. *Nonatelia*, but its leaves lack this group's characteristic venation. The type collection of *Psy. cujabensis* has immature inflorescences with only young flower buds, but its peduncles are already well developed and flexuous and the corolla lobes are smooth abaxially in bud. The identity of this species is not entirely clear. It does demonstrably belong to *Palicourea*, but its relationships within this genus cannot be determined. *Psychotria cujabensis* does appear to be more similar to *Psy. deflexa* than to the species of *Palicourea* sect. *Nonatelia*, but this relationship hypothesis is based only on overall aspect. The name *Psy. cujabensis* has sometimes been confused with the name *Pal. cujabensis* Schtldl., which is a synonym of *Pal. croceoides* Ham., which belongs to *Palicourea* sect. *Crocothyrsae* Griseb. (Taylor, 1997a).

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A New Infraspecific Taxon of *Iris laevigata* (Iridaceae) in Northeast China

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ABSTRACT. A new variety of *Iris laevigata* Fisch. (Iridaceae) is described from Jilin Province in northeastern China. The new variety *I. laevigata* var. *alba* Ling Wang, L. Su & F. J. Shang differs from the typical variety of the species by tepals that are mostly white (vs. dark blue). Further, the color of the anthers is white with a blue tinge in the new variety (vs. entirely blue in the autonymic variety). The diameter of the flower in *I. laevigata* var. *alba* is much greater, ca. 12–14 cm (vs. usually 9–10 cm in *I. laevigata* var. *laevigata*).

Key words: China, Heilongjiang, Iridaceae, IUCN Red List.

The genus *Iris* L. (Iridaceae) was established in Linnaeus's *Species Plantarum* in 1753, based on the species *I. germanica* L. *Iris laevigata* Fisch. is widely distributed in Heilongjiang, Liaoning, Jilin, and Yunnan Provinces as both wild and cultivated populations, although no infraspecific taxa have yet been described.

Recent fieldwork and herbarium research support the description of a new variety within *Iris laevigata*. *Iris laevigata* var. *alba* Ling Wang, L. Su & F. J. Shang belongs to *I. laevigata*, with which it shares a similar height, flowering time, and number of flowers per stem. The new taxon is described, based on variable characters of the tepals that are considered taxonomically significant.

1. Iris laevigata Fisch., Index Sem. (St. Petersburg) 5: 36. 1839. TYPE: Russia. Hab. in paludibus prope Irkutzk et in Dahuria, s.d., s. coll. (holotype, LE not seen). Figure 1.

1a. Iris laevigata Fisch. var. **laevigata.**

1b. Iris laevigata Fisch. var. **alba** Ling Wang, L. Su & F. J. Shang, var. nov. TYPE: China. Heilongjiang: Harbin, cultivated on campus of NEFU, 15 June 2012, *L. Wang 002* (holotype, NEFU). Figure 2.

Diagnosis This new variety differs from *Iris laevigata* Fisch. var. *laevigata* by its tepals that are white, sometimes with a central yellow zone (vs. dark blue), the anthers that are white with a blue tinge (vs. entirely blue), and the flower diameter of ca. 12–14 cm (vs. usually 9–10 cm).

Perennial, herbs, rhizomes creeping, thick, ca. 1 cm in diam. Leaves grayish green, sword-shaped or broadly linear, 40–100 × 1–2 cm, midvein absent, base surrounded by maroon-brown fibers. Peduncle ca. 85 cm, solid; spathes 4, highly unequal, 5.5–7 × 1–1.5 cm, 2- or 3-flowered, proximal ones shorter with apex usually acute, distal ones longer, uppermost usually obtuse; pedicel 1.5–3.5 cm. Flowers nearly pure white, 12–14 cm in diam., perianth tube ca. 2 cm; outer segments obovate to elliptic, with a central, white or yellow zone, limb 7.5–9 × 3–3.5 cm; inner segments erect, oblanceolate, 5–6.5 × 0.8–1.5 cm; stamens ca. 3 cm; anthers blue-tinted white; ovary ca. 2 cm × 5–7 mm; style branches 5–6 × ca. 1.2 cm; stigmas 2-lobed. Capsule ellipsoid-cylindric, 6.5–7 × 2–2.5 cm, apex not beaked; seeds brown, semiorbicular, flat, ca. 6.5 × 5 mm.

Phenology. *Iris laevigata* var. *alba* was observed to flower in May through June, with fruit seen in July through August.

Distribution and habitat. *Iris laevigata* var. *alba* was cultivated from naturally growing specimens from Fuxing village, Daxing ditch, Wangqing County, Yanbian Korean Autonomous Prefecture of Jilin Province in 2011, and it has not been found in other places. The white color of the tepals remained stable after five years of cultivation in the nursery at Northeast Forestry University campus at Harbin in Heilongjiang Province. Plants have been propagated from vegetative offshoots.

IUCN Red List category. *Iris laevigata* var. *alba* is considered Not Evaluated (NE), according to the IUCN Red List (2012) categories and criteria because of uncertainty about its natural distribution.

Discussion. The new variety, *Iris laevigata* var. *alba*, differs from other varieties in *I. laevigata* by the pure white color of the tepals. The anthers are white with a blue tinge. The diameter of the flower is ca. 12–14 cm, much wider than in *I. laevigata* var. *laevigata*.

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Figure 1. *Iris laevigata* Fisch. Paratype, *L. Wang 008* (NEFU).

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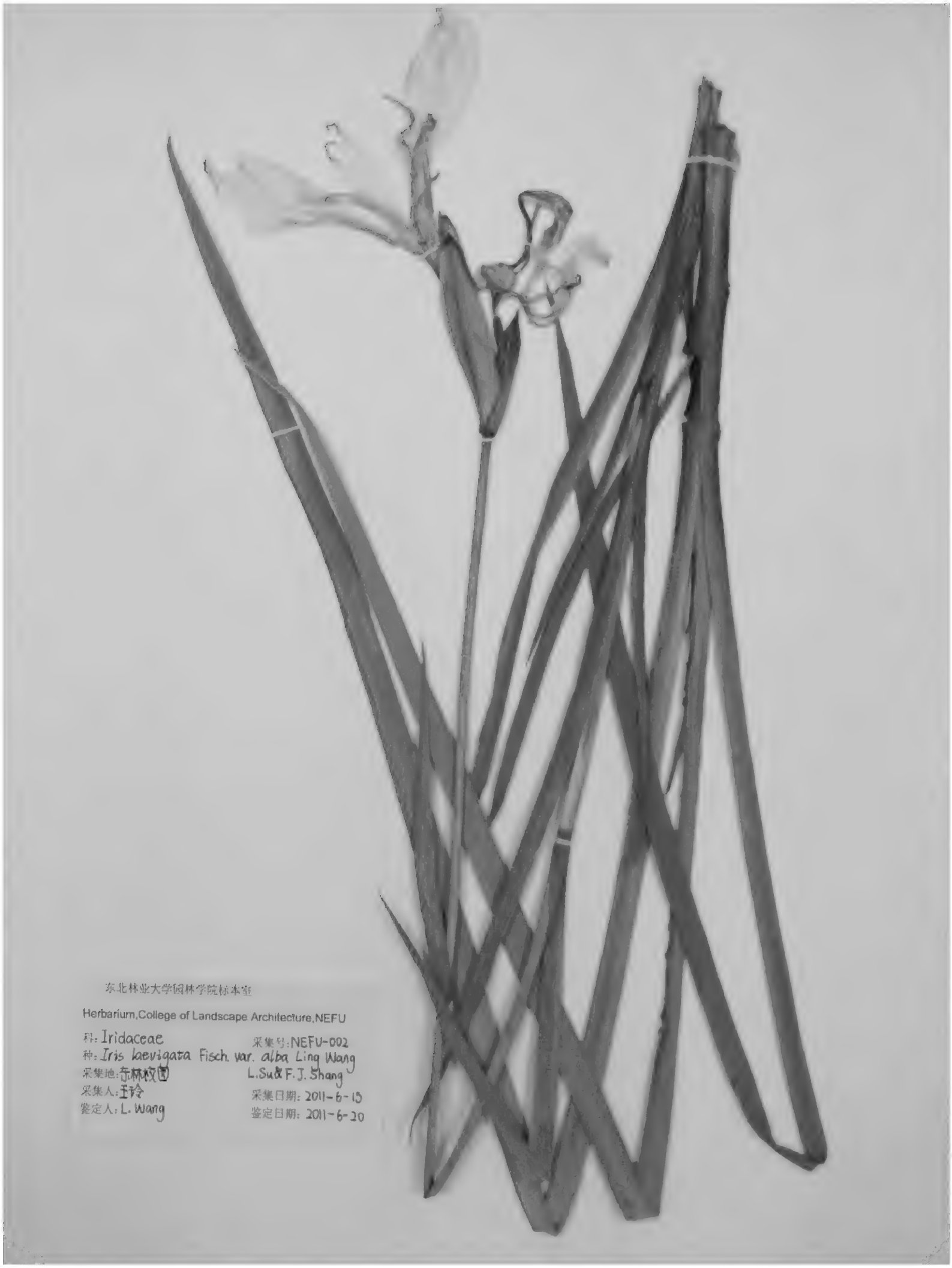

Figure 2. *Iris laevigata* Fisch. var. *alba* Ling Wang, L. Su & F. J. Shang. Holotype, *L. Wang 002* (NEFU).

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Typification and Validation of Names in Korean *Rubus* (Rosaceae)

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Abstract. Four names by T. Nakai are validly established within Korean *Rubus* L. (Rosaceae). The invalid name "*R. coreanus* Miq. var. *concolor* Nakai" is newly described as *R. coreanus* var. *concolor* Nakai ex J. Y. Yang from Gyeongsangnam-do Province in southeastern Korea. The invalid name "*R. phoenicolasius* Maxim. var. *albiflorus* Nakai" is newly described as *R. phoenicolasius* var. *albiflorus* Nakai ex J. Y. Yang from Jellanam-do Province in southwestern Korea. The invalid name "*R. tozawai* Nakai" is corrected for its epithet and newly described as *R. tozawae* Nakai ex J. Y. Yang from southeastern Korea. The new variety *R. tozawae* var. *longisepalus* J. Y. Yang is described from Gyeongsangnam-do Province in southeastern Korea. Lectotypes are designated for *R. coreanus*, *R. coreanus* var. *nakaianus* H. Lév., and *R. quelpaertensis* H. Lév.

Key words: Korea, Nakai, Rosaceae, *Rubus*.

One of the most important figures in the investigation of the Korean flora is Takenoshin Nakai (1882–1952). Nakai, who held a position at the University of Tokyo, carried out a total of 17 commissioned floristic expeditions by the Japanese Government General of Korea from 1913 to 1942 and collected extensively. Nakai's specimens are mostly held in the herbarium at TI (Tokyo University). Among Nakai's important works on the Korean flora were the *Flora Koreana* (1909, 1911), *Flora Sylvatica Koreana* (1915–1936), and *A Synoptical Sketch of Korean Flora* (1952). In the latter, Nakai listed a total of 4191 vascular plant taxa in Korea: 3176 species, 841 varieties, and 174 forms. Approximately 25% of the plant names in the list (i.e., 642 species, 402 varieties, and 70 forms) were newly described by Nakai. Although Nakai's lifelong studies contributed significantly to the Korean flora, his taxonomic novelties have been criticized as based on minor morphological differences and their taxonomic significance controversial. Furthermore, many of the Nakai names, even if invalidly published, have rarely been scrutinized, yet they have been used in recent Korean taxonomic literature, e.g., *Illustrated Flora of Korea* (W. C. Lee, 1996; Y. N. Lee, 1996, 2006; T. B. Lee, 1980) and *The Genera of Vascular Plants of Korea* (Park, 2007).

One group known to have nomenclatural problems is the genus *Rubus* L. (Rosaceae). Momiyama and Ohba (1988) indicated that four Nakai names, "*R. coreanus* Miq. var. *concolor* Nakai" (Nakai, 1915), "*R. longisepalus* Nakai" (attributed to Nakai ex Kawamoto; Chung, 1943), "*R. phoenicolasius* Maxim. var. *albiflorus* Nakai" (Mori, 1922), and "*R. tozawai* Nakai" (attributed to Nakai ex Kawamoto; Chung, 1943), were invalidly published. Two of these names, "*R. coreanus* var. *concolor*" and "*R. phoenicolasius* var. *albiflorus*," lack published descriptions and are in fact nomina nuda, with no types specified. The names "*R. longisepalus*" and "*R. tozawai*" have been described in Japanese as new taxa (Kaburaki, 1940), but without Latin diagnoses or designation of types. These nomenclatural omissions were acknowledged by Eom et al. (2010). Therefore, these four names

are not validly published under Articles 39.1, 39.2, 7.10, and 9.1 of the Melbourne Code (McNeill et al., 2012). Three of them are validated herein, and the fourth validly published at the varietal level.

1. Rubus coreanus Miq., Ann. Mus. Bot. Lugduno-Batavi 3: 34. 1867. TYPE: Korea. s. loc., June 1863, *R. Oldham 215* (lectotype, designated here, K [barcode] K000639573 [plant at right], K image; isolectotypes, GH [bc] 00135098, GH image, L [bc] L0043343, L image, P [bc] P00755201, P image). Figure 1.

Shrubs, deciduous, 1–3 m tall; branches erect first and tips bending and rooting upon contact with the ground; stem purplish red, with straight, flattened, curved prickles and glaucous bloom. Leaves alternate, 5- or 7-foliolate, rarely 3-foliate; petiole 1–5 cm, lateral leaflets subsessile; leaflets ovate, obovate, or oblong, 3–7 cm, apex acute, base cuneate to subrounded, margin irregularly sharply toothed, abaxially gray-pubescent or only along veins or shortly tomentose, adaxially glabrous or pubescent only along veins; rachis and petiolule pubescent, with sparse, curved, minute prickles; stipules linear-lanceolate, 4–7 mm, soft-hairy. Inflorescence terminal on lateral short branchlets, corymbose, erect; pedicel 5–10 mm. Flower with the calyx abaxially gray-pubescent, spreading at anthesis, reflexed in fruit; sepals ovate-lanceolate, apex acuminate to caudate; petals pale pink, obovate, shorter than sepals; stamens numerous. Fruit aggregate, subglobose, dark red to black.

Phenology. *Rubus coreanus* flowers in July and August.

Distribution. In Korea, *Rubus coreanus* occurs in montane valleys, roadsides, and open forests. The species also occurs widely in southern China and is rarely cultivated in Japan.

Vernacular name. Bok-bun-ja-ttal-gi (Chung et al., 1937).

Typification. The name *Rubus coreanus* was validly established by Miquel, with the single collection *Oldham 215*. Among the several duplicates, the K specimen with the June 1863 date collected as *Oldham 215* is designated as lectotype. The K sheet is a mixed collection, with the plant at the upper left being *Oldham 1041*. According to Article 9.12 (McNeill et al., 2012), we designate herein R. Oldham's collection *215* (K [bc] K000639573) as the lectotype (Fig. 1).

1a. Rubus coreanus var. **coreanus.**

Rubus quelpaertensis H. Lév., Feddes Repert. Spec. Nov. Regni Veg. 5: 280. 1908, syn. nov. TYPE: Korea. Quelpaert, June 1907, *Faurie 1584* (lectotype, designated here, E [barcode] E00313539, E image; isolectotypes, P [bc] P00755203, image, TI [bc] TI00560, image).

Rubus coreanus Miq. var. *nakaianus* H. Lév., Feddes Repert. Spec. Nov. Regni Veg. 8: 358. 1910, syn. nov. TYPE: Korea. Quelpaert, Mt. Hallaisan, June 1909, *E. J. Taquet 2835* (lectotype, designated here, E [barcode] E00313542, E image).

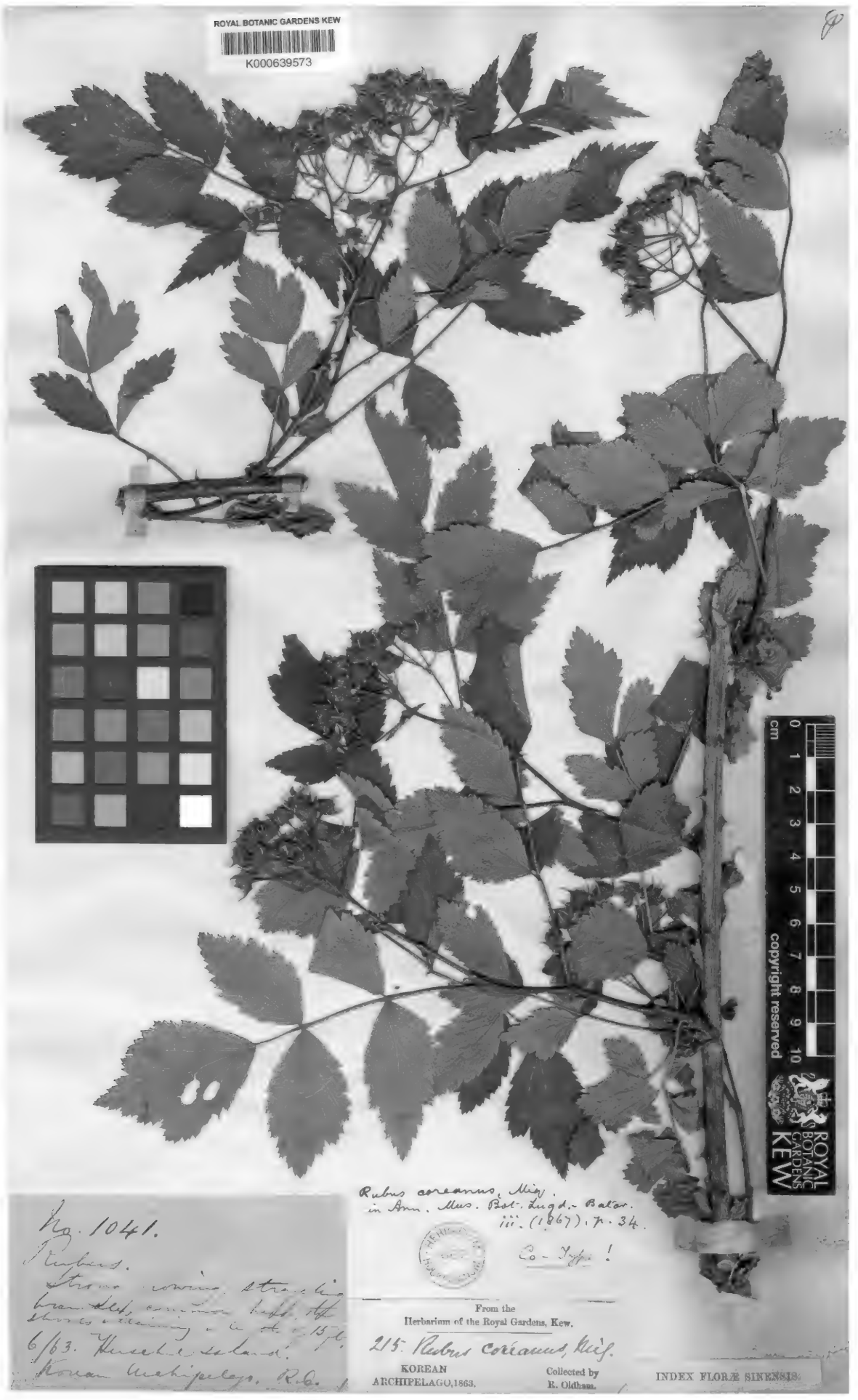
Rubus pseudosaxatilis H. Lév., Feddes Repert. Spec. Nov. Regni Veg. 5: 280. 1908, as "*pseudo-saxatilis*," syn. nov. TYPE: Korea. Quelpaert, June 1907, *Faurie 1587* (holotype, E [barcode] E00010577, E image).

Rubus pseudosaxatilis var. *kouytchensis* H. Lév., Feddes Repert. Spec. Nov. Regni Veg. 5: 280. 1908, syn. nov. TYPE: China. Kouy-Tcheou, Pin-Fa, May 1902, *Cavalerie 1256* (holotype, E [barcode] E0031340, E image).

Leaves discolorous, adaxially shiny green, glabrous or pubescent only along veins, abaxially gray-pubescent.

Discussion. Léveillé (1908) recognized *Rubus pseudosaxatilis*, a species with 3- to 5-foliolate leaves with long petioles and unequal, mostly long petiolules, and grayish white tomentose sepal margins, whose variety, *R. pseudosaxatilis* var. *kouytchensis*, has relatively narrow-sepaled and rose-colored flowers. Also, he distinguished *R. quelpaertensis* by its reddish brown branches, 5-foliolate leaves with leaflets subsessile or unequally short-petiolate, and black fruits. Moreover, in the description of *R. coreanus* var. *nakaianus*, Léveillé (1910) suggested that this new variety had minute flowers and was otherwise similar to *R. coreanus*. However, *R. coreanus* included morphological variation such as leaves 5- to 7-foliolate, rarely 3-foliolate, petiole 1–5 cm, lateral leaflets subsessile, corymbs 2.5–5 cm, several to more than 30-flowered, flowers 7–10 mm in diameter, pedicels 5–10 mm, petals pink to dark red, and fruits dark red or purplish black. Therefore, the distinct features of new species and new varieties that Léveillé (1908, 1910) recognized fall within the morphological variation of *R. coreanus*. Hence, *R. coreanus* var. *nakaianus* and *R. quelpaertensis* are synonymized under the name *R. coreanus*.

Although Léveillé was a French botanist, his types were purchased in 1919 by E and this included Faurie collections (Stafleu & Cowan, 1979: 863). For *Rubus quelpaertensis*, two collections were noted in the protologue: *Faurie 1584*, June 1907, and *Faurie 1585*, July 1907. Several duplicates were seen for both syntypes and the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copyright reserved
ROYAL BOTANIC GARDENS KEW
Rubus coreanus, Miq. in Ann. Mus. Bot. Lugd.-Batav. iii. (1867), p. 34.
Co-Type!
From the Herbarium of the Royal Gardens, Kew.
215. Rubus coreanus, Miq.
KOREAN ARCHIPELAGO, 1863.
Collected by R. Oldham.
INDEX FLORÆ SINENSIS:

Figure 1. The lectotype of *Rubus coreanus* Miq. deposited in K (*R. Oldham 215*).

earlier collection at E is selected as lectotype. For *R. coreanus* var. *nakaianus*, three collections were noted in the protologue: *E. J. Taquet 2834*, *2835*, and *2845*, June 1909. These three collections at E were seen for syntypes, and Taquet's unnumbered collections at A were seen for isosyntypes. We selected the *E. J. Taquet 2835* collection at E as lectotype, because it is better preserved.

Specimens examined. KOREA. **Quelpaert Ilê:** July 1907, *Faurie 1585* (syntype of *Rubus quelpaertensis*, A [barcode] A00040712 [fragments of *Faurie 1584*], A image, E [bc] E00010576, E image, P [bc] P00755202, P image); Hallaisan, June 1909, *E. J. Taquet 2834*, *2845* (syntype of *R. coreanus* var. *nakaianus*, E [bc] E00010578, E image, E [bc] E00313541, E image), June 1909, *E. J. Taquet s.n.* (syntype of *R. coreanus* var. *nakaianus*, A [bc] A00040555, A image, A [bc] A00040556, A image).

Figure 2. The holotype of *Rubus coreanus* Miq. var. *concolor* Nakai ex J. Y. Yang deposited in TI (*T. Nakai 135*).

1b. Rubus coreanus var. **concolor** Nakai ex J. Y. Yang, var. nov. TYPE: Korea. Gyungsangnam-do: Mt. Jiri, 30 June 1913, *T. Nakai 135* (holotype, TI [barcode] TI00332). Figure 2.

Diagnosis. *Rubus coreanus* Miq. var. *concolor* Nakai ex J. Y. Yang is similar to *R. coreanus* var. *coreanus*, but is distinguished by its leaves concolorous, abaxially pale green, and glabrous on both surfaces.

Iconography. Momiyama & Ohba, 1988: pl. 50.

Vernacular name. Cheong bok bun ja ttal gi (Chung, 1943).

Distribution. *Rubus coreanus* var. *concolor* is restricted to two southern provinces of Korea, from Gyungsangnam-do and Jeju-do. The variety occurs in montane roadsides and open-spaced forests in elevations between 300 and 1000 m.

Discussion. T. Nakai's collection *135* at TI is designated here as holotype. The TI sheet has been annotated by Nakai as "concolor Nakai," although he did not indicate its rank. The form name, "*Rubus coreanus* f. *concolor* (Nakai) T. Lee (1966)," is also invalid because it was based on the invalidly published "*R. coreanus* var. *concolor*" and no validating detail was provided for the form. *Rubus coreanus* var. *concolor* is distinguished by its abaxially pale green and glabrous leaves, which are otherwise abaxially gray-pubescent in the autonymic variety.

Paratype. KOREA. **Gyeongsangnam-do:** Mt. Jiri, 26 May 1998, *J. Y. Yang 223* (KNU).

2. Rubus phoenicolasius Maxim., Bull. Acad. Imp. Sci. Saint-Pétersbourg 17(2): 160–161. 1872. TYPE: Japan. "Japonia. Oshima, Hokodate, ad lacum Konoma secus vias humidas in herbosis elatis," 3–15 July 1861 (fl., fr.), *C. J. Maximowicz s.n.* (lectotype, designated by Buzunova [2001: 247], LE not seen; isolectotypes, GH [barcode] 00040701, GH image, K [bc] K000737878, K image, LE [4] not seen, NY [bc] 00429708, NY image).

Shrubs, deciduous, 1–3 m tall; branches erect first and tips bending, with dense reddish brown glandular hairs intermixed with reddish brown bristles, and sparse, flattened, reddish brown prickles; branches from previous year brown with reddish brown bristles, sparse, flattened, reddish brown prickles. Leaves alternate, 3-foliolate, rarely 5-foliate; blade of leaflets broadly ovate, 4–6 cm, abaxially densely gray-tomentose, bristly, sparsely glandular, adaxially appressed-pubescent, thinly prickly and glandular-pilose, apex acute to acuminate, base rounded to subcordate, margin irregularly roughly serrate, usually incised; terminal leaflet largest and often lobed; lateral ones widely ovate; stipules linear to lanceolate. Inflorescence terminal or axillary, racemes erect; rachis densely reddish brown glandular-pubescent; pedicel short, 8–15 mm; bracts pluri-laciniate, lanceolate. Flowers with sepals densely pubescent, bristly, stipitate-glandular, lanceolate, 7 mm; petals spatulate, acute, pubescent basally, pale red or pink, 4 mm; stamens numerous, slightly shorter than petals; pistils longer than stamens; ovary glabrous or puberulous. Fruit aggregate, subglobose, and ripening red.

Phenology. *Rubus phoenicolasius* fruits in July.

Distribution. *Rubus phoenicolasius* occurs commonly in all provinces of Korea, especially along roadsides and montane valleys at elevations of 500 m and above. The species also occurs in central and southern China (Lu & Bufford, 2003) and Japan (Ohwi, 1953) and is naturalized in Europe and North America. Cultivated *R. phoenicolasius* also occurs in southern Australia, but only in the state of Victoria (Australia's Virtual Herbarium [AVH], <http://avh.ala.org.au>). *Rubus phoenicolasius* in North America and Australia has white petals rather than pale red or pink.

Vernacular name. Burk-eun-ga-si-ttal-gi (Chung et al., 1937).

Discussion. The protologue for *Rubus phoenicolasius* mentioned collections by Albrecht [s.n.] and Tschonoski [s.n.] as well as "ipse [himself]" by Maximowicz (1872: 160). Unnumbered collections by Albrecht and Tschonoski were deposited in LE and were identified as syntypes by Buzunova (2001). There are multiple sheets attributed to Maximowicz at different months in 1861 and that mention Konoma Lake ("ad lacum Konoma," Maximowicz, 1872: 160): GH [barcode] 00040701, July 1861; K [bc] K000737878, July 1861; L [bc] L0043352, 1861 only; the LE sheet of *Maximowicz s.n.*, July 1861, not seen; NY [bc] 00429707-8, 1861 only; P [bc] P00755395, 1861 only. Only three sheets specify July 1861, which correspond with the protologue: GH [barcode] 00040701, K [bc] K000737878, LE sheet, July 1861. Sheet labels on all Maximowicz specimens specify "ex herb. Horti bot. Petropolitani" and the LE herbarium was Carl Johann Maximowicz's principal institution. Among all these candidate sheets, Buzunova (2001) designated the LE sheet of *Maximowicz s.n.* as the lectotype, with four isolectotypes. The two remaining sheets that carry the July 1861 date (GH [bc] 00040701, K [bc] K000737878), are also identified here as isolectotypes.

Specimens examined. JAPAN. **Hokkaido:** Insula Jesso, ca. Hakodate, 1861–1863 (fl.), *Albrecht s.n.* (LE); Hakodate ad lacum Konoma, July 1861, *C. J. Maximowicz s.n.* (GH [barcode] GH00040701), GH image; Hakodate Konoma lake, July 1861, *C. J. Maximowicz s.n.* (K [bc] K000737878), K image; Hakodate Konoma, June 1861,

C. J. Maximowicz s.n. (L [bc] L0043352), L image; Hakodate, 1861, *C. J. Maximowicz s.n.* (NY [bc] 00429707), NY image; Hakodate ad lacum Konome, 1861, *C. J. Maximowicz s.n.* (NY [bc] 00429708), NY image; Hakodate, 1861, *C. J. Maximowicz s.n.* (P [bc] P00755395), P image; Nippon Prov. Senano, 1864, *S. Tschonoski s.n.* (K [bc] K000737877), K image, *S. Tschonoski s.n.* (M [bc] M0214145), M image; Nippon Senano Prov. Silvae montanae, 1864, *S. Tschonoski s.n.* (MO-1929634, [bc] 255136), MO image; Prov. Senano, 1864, *S. Tschonoski s.n.* (P [bc] P00755320), P image, *S. Tschonoski s.n.* (P [bc] P00755321), P image; Nippon media, 1866, *S. Tschonoski s.n.* (GH [bc] 00040702), GH image, *S. Tschonoski s.n.* (K [bc] K00737876), K image.

2a. Rubus phoenicolasius var. **phoenicolasius.**

Branches with dense reddish brown glandular hairs intermixed with reddish brown bristles, and sparse flattened reddish brown prickles; petal pale red or pink.

2b. Rubus phoenicolasius var. **albiflorus** Nakai ex J. Y. Yang, var. nov. TYPE: Korea. Jellanam-do: Wan-do, 20 June 1913, *T. Nakai 775* (holotype, TI [barcode] TI00546). Figure 3.

Diagnosis. *Rubus phoenicolasius* Maxim. var. *albiflorus* Nakai ex J. Y. Yang is similar to *R. phoenicolasius* var. *phoenicolasius*, but this variety is distinguished by the branches with sparse, flattened, reddish brown prickles and dense reddish brown glandular hairs; petals white.

Iconography. Momiyama & Ohba, 1988: pl. 113, holotype.

Distribution. *Rubus phoenicolasius* var. *albiflorus* is restricted to the one island, Wan-do Island, of the southwestern province, Jellanam-do, in Korea where it occurs along coastal montane roadsides.

Vernacular name. Huin gom ttal gi (Lee, 1966).

Discussion. *Rubus phoenicolasius* var. *albiflorus* is distinguished by its white flowers, which are otherwise purplish red or pink in the autonymic variety. A form name, "*R. phoenicolasius* f. *albiflorus* (Nakai) T. B. Lee" (Lee, 1980), is invalid because it was based on the nomen nudum, "*R. phoenicolasius* var. *albiflorus* Nakai" (Mori, 1922), itself also invalid. *Rubus phoenicolasius* var. *phoenicolasius* has red or purplish red petals and occurs widely in all provinces in Korea as well as in central and southern China (Lu & Bufford, 2003). *Rubus phoenicolasius* var. *phoenicolasius* with pale pink petals also occurs in Japan (Ohwi, 1953). *Rubus phoenicolasius* var. *albiflorus* is distinguished by its white flowers and is restricted to Wan-do Island in the southwestern province, Jellanam-do, in Korea. Naturalized *R. phoenicolasius* in North America has white petals. However, we need additional research to determine whether the naturalized form is variety *albiflorus*. Only one record of *R. phoenicolasius* occurs in south Australia as cultivated with white petals.

Typification. We designate herein T. Nakai's collection *775* (TI00546) as the holotype (Fig. 3.) since it has been annotated by Nakai as "forma albiflora Nakai." The specimen had been previously stamped erroneously as "Holotypus," although the name was not validly published until now.

Paratype. KOREA. **Jellanam-do:** Wan-do, 20 May 1998, *J. Y. Yang 91* (KNU).

3. Rubus tozawae Nakai ex J. Y. Yang, sp. nov. TYPE: Korea. Gyeongsangnam-do: Geoje-do, Jisepo, 2 May 1928 (fl.), *T. Nakai 11452* (holotype, TI [barcode] TI00606). Figure 4.

Diagnosis. *Rubus tozawae* Nakai ex J. Y. Yang is similar to *R. ribisoideus* Matsum., which has stems unarmed, leaves 3- to 5-lobed and well spaced along the stem, calyces to 2 cm, and the tip of one sepal lobe sometimes elongated and foliaceous. *Rubus tozawae* is distinguished from *R. ribisoideus* by its stems with prickles, leaves densely compact along the stem, and shorter calyces less than 1 cm.

Shrubs, deciduous, erect, 2 m tall; branchlets greenish brown with prickles and arranged with densely compact leaves. Leaves simple, alternate, subtriangular-orbicular, 2–5 × 2–6 cm, apex acute to shortly acuminate, base cordate-truncate, usually shallowly 3-cleft or -lobed, rarely 5-cleft; blade margin double-toothed, abaxially pubescent and with prickles along veins, adaxially glabrous and without prickles; petiole 2–4 cm, with prickles, sparsely pubescent; stipules linear, 4–6 mm, thinly pubescent. Inflorescence terminal on lateral short branchlets, solitary; pedicels 0.5–1 cm, with fine hairs, prickly, nodding at anthesis. Flower with calyx abaxially finely pubescent, less than 1 cm, sepals lanceolate, mucronate, 3.5–4.5 × 8.3–10 mm; petals white, ovate-orbicular, 3–5 × 6–7 mm; stamens erect, numerous, filaments linear, pistils numerous, slightly shorter than stamens. Fruit aggregate, yellow, globose, ca. 1 cm diam.

Iconography. Momiyama & Ohba, 1988: pl. 141, syntype.

Phenology. *Rubus tozawae* flowers from April to May and fruits from May to August.

Distribution. *Rubus tozawae* is endemic to two islands, Geje-do and Gemum-do, from the southern

Figure 3. The holotype of *Rubus phoenicolasius* Maxim. var. *albiflorus* Nakai ex J. Y. Yang deposited in TI (*T. Nakai 775*).

provinces of Gyeongsangnam-do and Jellanam-do, respectively, in Korea. The species occurs in lower coastal areas on these islands.

Vernacular name. Geo je ttal gi (Chung, 1943).

Discussion. According to Recommendation 60C. 1(a) (McNeill et al., 2012), the specific epithet *tozawai* should use the appropriate Latin case ending in the genitive as *tozawae*. The name, "*Rubus tozawai* Nakai" (Kaburaki, 1940; Chung, 1943; Nakai, 1952),

Figure 4. The holotype of *Rubus tozawae* Nakai ex J. Y. Yang deposited in TI (*T. Nakai 11452*).

was not validly published by Nakai or others, since no Latin description was included and the text was written only in Japanese. Without specific reference, Momiyama and Ohba (1988) and Suh et al. (2006) used "*R. tozawai* Nakai ex Kawamoto" during digital image processing for the type specimen in TI. The author ascription of Kawamoto refers to T. H. Chung's Japanese name under Japanese colonial rule. The attribution of "*R. tozawai* Nakai ex T. H. Chung" was used to clarify the author's name of Kawamoto in the

National List of Species of Korea (Lee et al., 2011). "*Rubus longisepalus* var. *tozawai* (Nakai) T. Lee" was also an invalid name because it was based on the previous invalidly published name, "*R. tozawai* Nakai."

Three specimens of *Rubus tozawae* were collected by T. Nakai from two southern provinces (Gyeongsangnam-do and Jellanam-do) in Korea and were deposited in TI. One specimen with flowers was collected on Geje Island in Gyeongsangnam-do Province, and *T. Nakai 11452* at TI is accepted as the holotype of the validated species name *R. tozawae*. The remaining two specimens were collected on Gemun Island from Jellanam-do Province, but both *T. Nakai 11450* and *11451* at TI are sterile collections. Momiyama and Ohba (1988) erroneously indicated these three specimens to be syntypes of the invalid species name. We designated the fertile specimen *T. Nakai 11452* (TI [barcode] TI00606) as the holotype (Fig. 4), because it is better preserved and has flowers. This sheet had been previously annotated as lectotype in error (Suh et al., 2006), presumably as part of the digitization process and since 1988 (cf. Momiyama & Ohba, 1988: pl. 141).

Paratypes. KOREA. **Gyeongsangnam-do:** Geje-do, Jisepo, 15 May 2010, *J. Y. Yang 1257* (KNU). **Jellanam-do:** Gemun-do, Seo-do, 24 May 1928, *T. Nakai 11450* (TI [barcode] TI00607), *11451* (TI [bc] TI00608).

KEY TO THE VARIETIES OF *RUBUS TOZAWAE*

1. Petiole with fine hairs and prickles; sepals less than 1 cm and of similar lengths .... *R. tozawae* Nakai ex J. Y. Yang var. *tozawae*
1′. Petiole finely pubescent and without prickles; sepals 1.3–1.9 cm, one lobe of sepal usually protruding beyond others .... *R. tozawae* Nakai ex. J. Y. Yang var. *longisepalus* J. Y. Yang

3a. Rubus tozawae var. **tozawae.**

Stems with prickles and densely compact leaves along the stems. Leaves subtriangular-orbicular, usually shallowly 3-lobed, rarely 5-lobed; petioles with fine hairs and prickles. Flowers with sepals less than 1 cm.

3b. Rubus tozawae var. **longisepalus** J. Y. Yang, var. nov. TYPE: Korea. Gyeongsangnam-do Geoje-do, 4 May 1928, *T. Nakai 11448* (holotype, TI [barcode] TI00495). Figure 5.

Diagnosis. *Rubus tozawae* Nakai ex J. Y. Yang var. *longisepalus* J. Y. Yang is similar to *R. tozawae* var. *tozawae*, which has densely compact leaves arranged along the stem, petioles with prickles, and a calyx with the sepals less than 1 cm. The new variety, *R. tozawae* var. *longisepalus*, differs in its leaves well spaced along the stem, petioles lacking prickles, and calyces with longer sepals 3.5–6.5 cm.

Stems with prickles and leaves well spaced along the stems. Leaves broadly deltoid-ovate, 4–6 × 5–7 cm, usually 3-lobed; petiole 1.5–3 cm, with fine hairs and prickles. Flowers with the sepals ovate-oblong, mucronate, 1.3–1.9 cm, pubescent, one lobe of sepal usually longer than the others; petals white, ovate-orbicular, 1.2–1.4 cm.

Vernacular name. Mac do ttal gi (Chung, 1943).

Distribution. *Rubus tozawae* var. *longisepalus* is endemic to two provinces in the southern portion of Korea; Gyeongsannam-do (Tong-young, Geoje) and Jellanam-do (Yeo-su). It occurs in mountainous foothills near coastal areas and to 100 m in elevation.

Discussion. "*Rubus longisepalus* Nakai" (Kaburaki, 1940; Chung, 1943; Nakai, 1952) was not validly published by Nakai or others, since no Latin description was included and the text was written only in Japanese. Later uses of "*R. longisepalus* Nakai ex Kawamoto" (Momiyama et al., 1988; Suh et al., 2006) and "*R. tozawai* var. *longisepalus* J. Y. Yang" (Yang & Pak, 2007) were based on Nakai's invalid name and were not validly published as new taxa since they lacked a Latin description. Also, "*R. longisepalus* Nakai" would have been a later homonym of *R. longisepalus* P. J. Müll. (Müller, 1861). Because of the priority of that name, Nakai's epithet of "*tozawae*," rather than "*longisepalus*," was adopted for the species herein recognized. However, we chose to use "*longisepalus*" for the new varietal name because no varieties have been established for *R. longisepalus*.

Two of Nakai's collections identified as *Rubus longisepalus* are deposited in TI. One collection was from Gyeongsangnam-do (*Nakai 11448*, TI [barcode] TI00495) and includes flowers, while the other from Gemun-do includes fruits (*Nakai 11449*, TI [bc] TI00496). Later, Momiyama and Ohba (1988) erroneously indicated these two specimens as syntypes of the invalid name "*R. longisepalus* Nakai ex Kawamoto," though they had not been cited as such in the protologue. The collection *Nakai 11448* (TI) has been previously annotated as "lectotype in error" for "*R. longisepalus* Nakai ex Kawamoto" (Suh et al., 2006). The collection *Nakai 11448* (TI) is designated here as holotype (Fig. 5) because it is better preserved, with key diagnostic features of this species. Until now, the

Figure 5. The holotype of *Rubus tozawae* Nakai ex J. Y. Yang var. *longisepalus* J. Y. Yang deposited in TI (*T. Nakai 11448*).

names of "*R. longisepalus* Nakai" and all synonyms have been based on Nakai's specimens that were deposited in TI. Therefore, to avoid taxonomic confusion, we have decided to use material that Nakai accepted as representative of the taxon rather than designating a more recent collection in a Korean herbarium.

Paratypes. KOREA. **Gyeongsangnam-do:** Geje-do, Jisepo, 15 May 2010, *J. Y. Yang 1260* (KNU). **Jellanam-**

do: Gemun-do, Dong-do, 26 May 1928, *T. Nakai 11449* (TI [barcode] TI00022398).

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Lectotypification of the Name *Linum carnosulum* var. *empetrifolium* (Linaceae)

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Abstract. A specimen of original material stored in the Herbarium of the Conservatoire et Jardin Botaniques la Ville de Genève (G) is designated as lectotype for the name *Linum carnosulum* Boiss. var. *empetrifolium* Schott & Kotschy ex Boiss. (Linaceae). Currently, this taxon, which is endemic to the flora of Turkey, is recognized as *L. empetrifolium* (Schott & Kotschy ex Boiss.) P. H. Davis.

Key words: Lectotypification, Linaceae, *Linum*, Turkey.

Linum L. is the largest genus among the flax family and comprises ca. 180 species, which are distributed in temperate and subtropical areas of the world (Mabberley, 1997). It is most diverse in Turkey, with 42 species around the Mediterranean area of which approximately one third are endemic (Davis, 1967a; Yılmaz et al., 2003; Yılmaz & Kaynak, 2006a, 2006b, 2008a, 2008b, 2008c, 2010, 2016; Tugay et al., 2010; Yılmaz, 2010; Greuter & Raus, 2012). One of these is *L. empetrifolium* (Schott & Kotschy ex Boiss.) P. H. Davis, which has a restricted distribution in South Anatolia. This species belongs to section *Linum* and is characterized by its dwarf habit with quite short stems, small imbricate leaves, and small blue flowers (Davis, 1967a).

The epithet "*empetrifolium*" was first used for a species name in Kotschy's book *Reise in den Cilicischen Taurus über Tarsus* (1858) without any description. Likewise, Tchihatcheff listed this name under "Species nondum descripta" in his work *Asie Mineure* (1860). Afterward, Boissier (1867) preserved this epithet but used it at the varietal level as *Linum carnosulum* Boiss. var. *empetrifolium* Schott & Kotschy ex Boiss., with an explanatory description. In *Flora Orientalis*, Boissier mentioned two type materials for this variety, which was collected at different times by Kotschy and Balansa from the type locality in the Bolkar Mountains in South Anatolia, Turkey. After Boissier's monumental work, the genus *Linum* was revised several times for the *Flora of Turkey*; however, the name *L. carnosulum* var. *empetrifolium* has not been correctly typified according to ICN, Article 9.2 (McNeill et al., 2012), until now.

Original material from the collections of Kotschy and Balansa is found in the Herbarium of the Conservatoire et Jardin Botaniques la Ville de Genève (G) and at the Herbarium of the Royal Botanic Garden Kew (K). One of Balansa's sheets from G is the most suitable among them, containing both mature flowers and fruits (C.H.G., 2016). Therefore, this sheet has been chosen as the lectotype.

Linum carnosulum Boiss. var. **empetrifolium** Schott & Kotschy. ex Boiss., Fl. Orient. 1: 864. 1867. TYPE: Région alpine du Taurus oriental, au dessus de Boulgarmaden, 1855, *Balansa s.n.* (lectotype, designated here, G-00330352; isolectotypes, G-00368430, K-000253989). Figure 1.

According to the latest taxonomical approach, this variety is considered to be a distinct species, namely *Linum empetrifolium*, which differs from *L. carnosulum* by its dwarf habit, mucronulate leaves, and nodding fruits (Davis, 1967a, 1967b).

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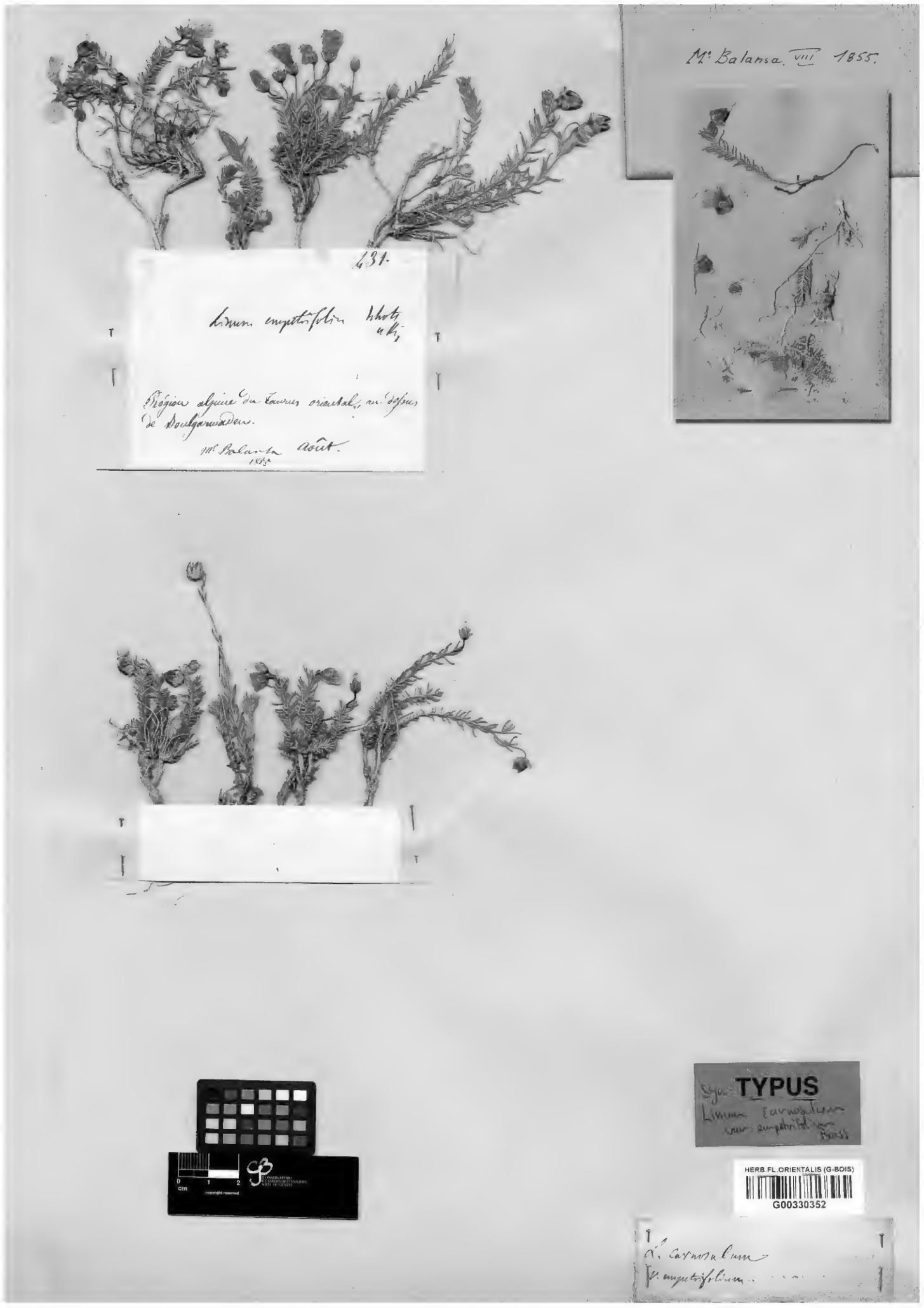

Figure 1. Lectotype of *Linum carnosulum* Boiss. var. *empetrifolium* Schott & Kotschy ex Boiss. (G-00330352). The photograph was taken with permission from the Herbarium of the Conservatoire et Jardin Botaniques la Ville de Genève (C.H.G. 2016).

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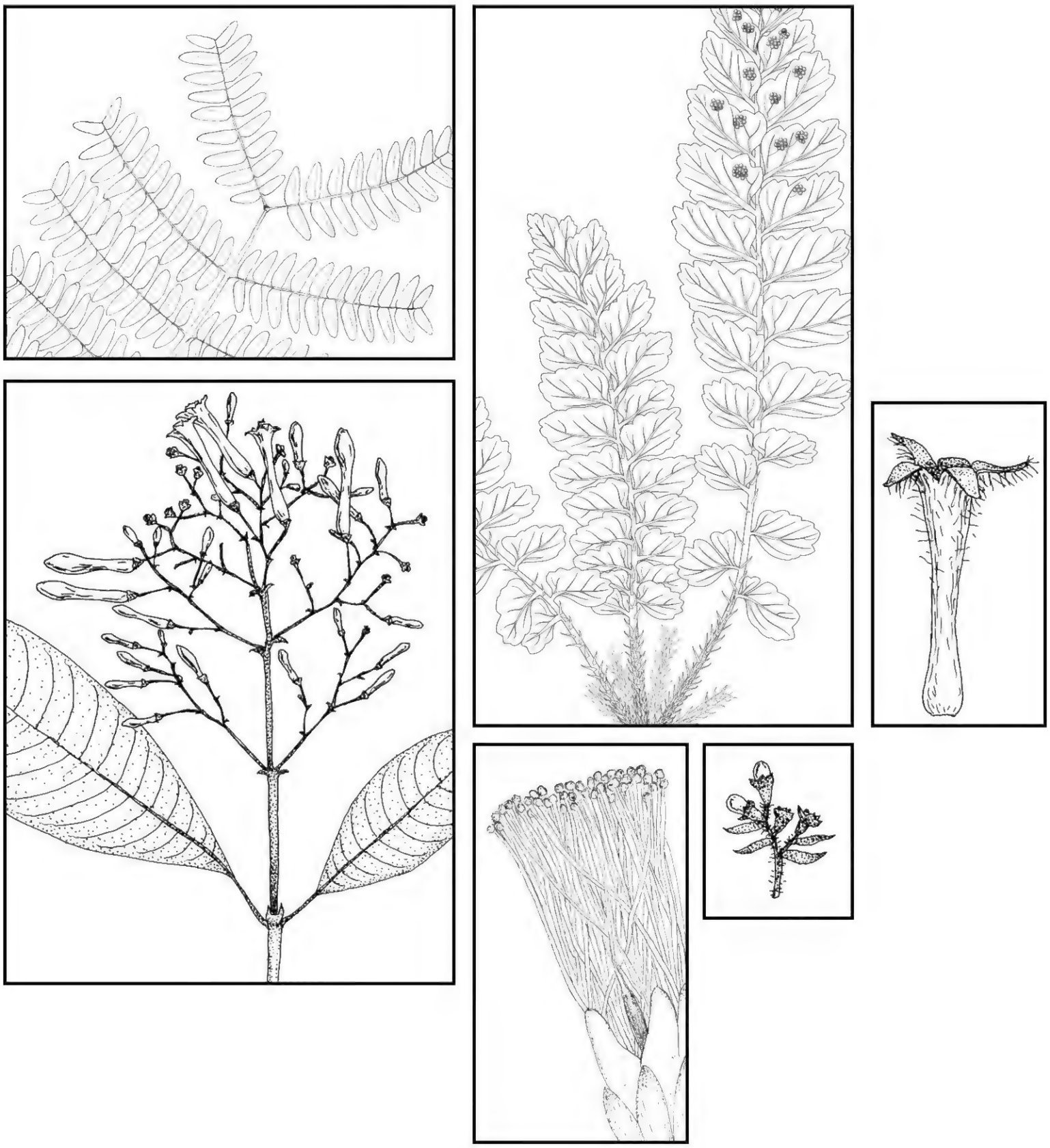

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Silene shehbazii (Caryophyllaceae), a New Species from Kurdistan, Iraq

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Abstract. *Silene shehbazii* S. A. Ahmad (Caryophyllaceae), a new species from Kurdistan, Iraq, is described, and characters distinguishing it from its nearest relatives, *S. odontopetala* Fenzl and *S. pseudonurensis* Melzh., are discussed.

Key words: Azmar-Goihza Mountain, Caryophyllaceae, Iraq, Kurdistan, *Silene*.

Silene L., the largest genus in the family Caryophyllaceae with some 700 species (Mabberley, 2008), is well represented in Southwest Asia, with some 119 species (34 endemic) in Turkey (Coode & Cullen, 1967), about 139 species (48 endemic) in Iran, and 37 species in Iraq (Melzheimer, 1988; Townsend et al., 2016).

During the past two years, extensive floristic study on the Azmar-Goizha Mountain (Kurdistan, Iraq) was conducted by the Kurdistan Botanical Foundation. Azmar-Goizha Mountain, which is a part of the extensive Zagros Mountain Range, overlooks Sulaimani City and occupies an area about 250 km² between 35°29′ to 35°42′N and 45°26′ to 45°33′E.

During recent studies in the Hawraman region (Ahmad, 2013a), four species were discovered as new to science (Ahmad, 2013b, 2014a, 2014b, 2014c) and 18 were discovered as new to the flora of Iraq (Ahmad, 2013c). The present botanical survey of the Azmar-Goizha Mountain also yielded several novelties and additions to the flora of Iraq, including the following species of *Silene*.

Silene shehbazii S. A. Ahmad, sp. nov. TYPE: Iraq. Kurdistan, Sulaimani Province, Azmar Mt., Khamza village, eroded places on mountainside, sandy soil, betw. the orchards, slope 35%–45%, sun exposure E to W, 1570 m, 35°38′57″N, 45°27′20″E, 30 Apr. 2015, *S. A. Ahmad, A. Hama, S. Babarasul & S. R. Fayaq 15-646* (holotype, KBFH!; isotype, SUFA!). Figure 1.

Diagnosis. The new species is apparently related to *Silene odontopetala* Fenzl and *S. pseudonurensis* Melzh., but it differs from the former by having leaves ovate to narrowly ovate (vs. lanceolate-linear), stems densely short-pubescent (vs. papillose) at base and densely glandular and viscid above (vs. densely papillose), and calyx 10–12 (vs. 12–18) mm long and ca. 4 (vs. ca. 10) mm broad at apex; it differs from the latter by the calyx 10–12 (vs. 16–20) mm long, petal limb 6–7 (vs. 3–5) mm long, anthophore 2.5–5 (vs. 5.5–10.5) mm long, and capsule broadly ovoid or ovoid-ellipsoid (vs. ovoid) and 5–7 (vs. 9–10.5) mm long; it differs from both by the taller stems and the glandular-viscid indumentum of the calyx.

Perennial herb with very woody rootstock. Stems pinkish, 30–45 cm tall, erect to ascending, densely short-hairy at base, densely glandular and viscid above. Basal leaves linear, oblanceolate, or elliptic, 20–50 × 3–9 mm, acute, margin ciliate, surfaces densely short-hairy, petiole 5–25 mm; cauline leaves ovate to ovate-lanceolate, 12–22 × 2–5 mm, acute, 1-veined, margin ciliate at base, surfaces densely short-pubescent. Inflorescence 6- to 8-flowered dichasium; dichasial branches pinkish, 5–7.5 cm; bracts ovate to narrowly so, 4–8 × 1–2 mm, pilose, glandular hairy, membranous at base, ciliate. Flower pedicels dark pink, 1–2 mm, glandular hairy; calyx cylindric to cylindric-clavate, dark pink, 10–12 × 2–2.5 mm, glandular, viscid, 10- to 12-veined, teeth broadly ovate, 1.5–2 × 0.8–1.2 mm, apex acute; petals pinkish, limb 6–7 mm, bifid to ca. 1/2 length, claw 9–10 mm; anthophore 2.5–5 mm, glabrous. Capsule broadly

Figure 1. *Silene shehbazii* S. A. Ahmad. —A. Plant. —B. Inflorescences. —C. Flower.

ovoid to ovoid-ellipsoid, 5–7 × 3–4 mm. Seed reniform, 0.5–1 × 1.5–2 mm, gray to gray brownish.

IUCN Red List category. *Silene shehbazii* is extremely rare and known from only a small population. Its IUCN Red List category (IUCN, 2001) remains uncertain and is currently assessed as Data Deficient (DD).

Etymology. The new species is named in honor of Dr. Ihsan A. Al-Shehbaz (Missouri Botanical Garden) in recognition of his help and advice throughout this study.

Discussion. *Silene shehbazii*, which is known only from Azmar Mountain, appears to be related to *S. odontopetala* (native to Lebanon, Iran, Iraq, Syria, Saudi Arabia, Egypt, Armenia, Azerbaijan, and Georgia) and the Iranian-endmic *S. pseudonurensis* (Table 1). It resembles the former in having narrow stem leaves and calyx strongly inflated in fruit. However, it differs substantially from *S. odontopetala* in having taller stems densely short-hairy at base, densely glandular and viscid above; a shorter and narrower calyx with glandular, viscid indumentum; and slightly smaller capsules. Both *S. shehbazii* and *S. pseudonurensis* have narrow stem leaves and pinkish petals bifid to about 1/2 length. However, *S. shehbazii* differs in having distinctly taller stems, shorter calyx and longer petal limb, shorter anthophore, and shorter, broader capsules (Table 1).

Paratypes. IRAQ. **Kurdistan**: Azmar Mt., Khamza village, 1490 m, 35°39′41″N, 45°27′18″E, 9 June 2014, *S. A. Ahmad, R. Ali, K. M. Ahmad & S. R. Fayaq 15-1297* (KBFH); Azmar Mt., Khamza village, 1490 m, 35°39′41″N, 45°27′18″E, 9 Nov. 2015, *S. A. Ahmad & S. R. Fayaq 15-1448* (KBFH).

Acknowledgments. I am profoundly grateful to Dr. Ihsan A. Al-Shehbaz (MO) for his advice and help

Table 1. Comparison between *Silene shehbazii* S. A. Ahmad, *S. odontopetala* Fenzl, and *S. pseudonurensis* Melzh.

	S. shehbazii	*S. odontopetala*	*S. pseudonurensis*
Plant height	30–45 cm	5–30 cm	15–25 cm
Cauline leaf shape	ovate to narrowly so	lanceolate, oblong, or narrowly ovate	lanceolate-linear
Calyx length	10–12 mm	12–18 mm	16–20 mm
Calyx width at apex	ca. 4 mm	ca. 10 mm	unknown
Calyx indumentum	glandular, viscid	puberulent	puberulent, glandular
Anthophore length	2.5–5 mm	2–5 mm	5.5–10.5 mm
Capsule shape	broadly ovoid or ovoid-ellipsoid	unknown	ovoid

throughout this study. I am equally grateful to Dr. Sarbagh Salih (President, Kurdistan Botanical Foundation) for her continuous support and to Mr. Fayaq Kollak for providing funds for the fieldwork. I thank two anonymous reviewers and the editorial staff of *Novon* for their critical comments. Last, but not least, I thank the American University of Iraq, Sulaimani (AIUS), for providing support and office space.

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Ahmad, S. A. 2013c. Eighteen species new to the flora of Iraq. Feddes Repert. 124: 65–68.

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Notes on the *Dimocarpus longan* (Sapindaceae) Complex

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Abstract. The *Dimocarpus longan* Lour. (Sapindaceae) species complex is reevaluated, and *D. longan* s.l. is divided into three species, of which two are divided into two varieties. Three new combinations, *D. cinereus* (Radlk.) Boonsuk & Chantar., *D. cinereus* var. *echinatus* (Leenh.) Boonsuk & Chantar., and *D. scandens* (Winit & Kerr) Boonsuk & Chantar., are here proposed. The name *Euphoria pallens* Pierre is lectotypified.

Key words: *Dimocarpus*, lam yai, longan, Sapindaceae.

The *Dimocarpus longan* Lour. (Sapindaceae) species complex includes five (or possibly six) taxa distributed from Sri Lanka, India, China, Taiwan, and throughout Southeast Asia to Papua New Guinea, in lowland evergreen and deciduous forests (Leenhouts, 1971; Adema et al., 1994). The modern taxonomy (following Leenhouts, 1971) treats the complex as a single species within which two subspecies are recognized: the widespread, mostly Asian subspecies *longan* and the primarily Malesian subspecies *malesianus* Leenh. Varieties *longan*, *longepetiolulatus* Leenh., and *obtusus* (Pierre) Leenh. are recognized within the former subspecies, and varieties *malesianus* Leenh. and *echinatus* Leenh. within the latter. Both subspecies occur in Thailand (van Welzen, 1999), where longan or lam yai is widely cultivated as an important and highly valuable fruit tree, especially in northern and southeastern Thailand. We have seen material from throughout the distribution of *D. longan*. The varieties of subspecies *longan* share flat midribs and reduced petals, which are as long as or shorter than the sepals. However, *D. longan* subsp. *malesianus* has distinct sunken midribs on the upper surfaces of the leaflets and well-developed and densely woolly petals, which are longer than the sepals. In our opinion, the subspecies are different enough to merit recognition at specific rank. The epithet with priority for the former subspecies *malesianus* at specific rank is that of *Sapindus cinereus* Turcz., which is accordingly transferred herein to *Dimocarpus* Lour.

Similarly, *Dimocarpus longan* var. *obtusus* differs from varieties *longan* and *longepetiolulatus* in its habit, leaflets, and fruits. It is a scandent shrub, rather than a tree; its leaflets have tomentose (rather than glabrous or subglabrous) abaxial surfaces and obtuse to emarginate (rather than acute or acuminate) apices; and its fruits are subglabrous rather than pustulate to granulate. In our opinion, these differences likewise suffice to merit recognition at specific rank. The epithet with priority at that rank is that of *Euphoria scandens* Winit & Kerr, which is accordingly transferred to *Dimocarpus*.

In this treatment, three species and four varieties are recognized within the *Dimocarpus longan* complex: *D. cinereus* (Radlk.) Boonsuk & Chantar. (varieties *cinereus* and *echinatus* (Leenh.) Boonsuk & Chantar.), *D. longan* (varieties *longan* and *longepetiolulatus*), and *D. scandens* (Winit & Kerr) Boonsuk & Chantar. Keys for this group are provided, and Table 1 documents the differences between the three species. Their leaves, inflorescences, flowers, and fruits are illustrated in Figures 1 and 2. The necessary new combinations are made below.

Key to the Species of the *Dimocarpus longan* Species Complex

1a. Midrib and veins on adaxial surface of leaflets sunken; petals longer than the sepals; fruits warty or with long spines ..... *D. cinereus* (Radlk.) Boonsuk & Chantar.

1b. Midrib and veins on adaxial surface of leaflets flat; petals as long as the sepals or shorter; fruits slightly pustulate, granulate, or smooth.

2a. Scandent shrub; apex of leaflets obtuse to emarginate, abaxial surface of leaflets tomentose ..... *D. scandens* (Winit & Kerr) Boonsuk & Chantar.

2b. Tree; apex of leaflets acute or acuminate, abaxial surface of leaflets glabrous to subglabrous ..... *D. longan* Lour.

1. Dimocarpus cinereus (Radlk.) Boonsuk & Chantar., comb. nov. Basionym: *Euphoria cinerea* Radlk., Sitzungsber. Math.-Phys. Cl. Königl. Bayer. Akad. Wiss. München 8: 299. 1878. *Sapindus cinereus* Turcz., Bull. Soc. Imp. Naturalistes Moscou 31(1): 402. 1858, nom. illeg., non *Sapindus cinereus* A. Cunn. ex A. Gray (1854). *Dimocarpus longan* Lour. subsp. *malesianus* Leenh., Blumea 19: 126. 1971.

Table 1. Comparison morphology and distribution of three species of *Dimocarpus* Lour.

	D. cinereus (Turcz.) Boonsuk & Chantar.	*D. longan* Lour.	*D. scandens* (Winit & Kerr) Boonsuk & Chantar.
Habit	tree	tree	scandent shrub
Petioles and rachis	tomentose	glabrous	glabrous
Apex of leaflets	acute to acuminate	acute to acuminate	obtuse to emarginate
Lower surface of leaflets	tomentose	glabrous	tomentose
Midrib on upper surface of leaflets	sunken	flat	flat
Petals	well developed, exceeding sepals	slightly reduced, as long as or shorter than sepals	reduced, shorter than sepals
Fruits	warty or with long spines	slightly pustulate	almost glabrous
Distribution	India, Thailand, Cambodia, Peninsular Malaysia, Singapore, Borneo, Celebes, Moluccas	Ceylon, India, China, Taiwan, Burma, Thailand, Vietnam, Peninsular Malaysia, Borneo, Philippines	Thailand, Vietnam

TYPE: Philippines. Luzon: South Ilocos, *H. Cuming 1131* (lectotype, designated by Leenhouts [1971: 123], probably in LE?; isolectotypes, BM-000884082!, C-10018598! [digital image], FI-006786! [digital image], K-000701852!, L-0013425! [digital image], L-0013426! [digital image]).

Discussion. Leenhouts (1971) published *Dimocarpus longan* subsp. *malesianus*, which was accepted for the *Flora Malesiana* area (Adema et al., 1994; Leenhouts, 1996), as a replacement name for *Sapindus cinereus* Turcz., nom. illeg. [≡*Euphoria cinerea* Radlk.], which was incorrectly described as its "basionym." He noted that its vegetative parts and fruits are variable but the flowers are rather uniform. The variation in size of the leaflets and fruits was the basis for classification into a few informal groups such as the "cinerea" and "gracilis" forms from the Philippines and the "malaiensis" form from north Borneo and Sumatra, to which some of the species-level synonyms correspond. Leenhouts (1971) and Adema et al. (1994) suggested that the "gracilis" form also occurs in continental Asia. We carefully examined specimens from herbaria and field surveys throughout the distribution of *D. longan* and found that although the leaflet size and fruits vary, the acute to acuminate leaflet apices, distinctly sunken midribs on the upper surface of the leaflets, development and pubescence of the petals, and warty or long-spiny fruits both unite the regional variants of this taxon and clearly distinguish it from *D. longan* (Figs. 1B, 2A–C, Table 1). Therefore, we conclude that these characteristics are sufficient to recognize *D. cinereus* at the specific level. The typical variety (formerly *D. longan* subsp. *malesianus* var. *malesianus* Leenh., now *D. cinereus* var. *cinereus*) and variety *echinatus* are not distinguishable in flower but can be separated based on the surface of their fruits, which are warty in variety *cinereus* but long-spined in variety *echinatus*. *Dimocarpus longan* subsp. *malesianus* var. *echinatus* is accordingly transferred to *D. cinereus*.

The original description of *Euphoria pallens* Pierre was based on two collections from Vietnam, *Pierre 4114* (P-02297305 and P-022973065) and *Harmand 688* (P-02297303 and P-02297304). Because *Pierre 4114* (P-022973065) is the best specimen, including leaves, inflorescence, and flowers, we select it as the lectotype.

KEY TO THE VARIETIES OF *DIMOCARPUS CINEREUS*

1a. Fruits warty ..... *D. cinereus* (Radlk.) Boonsuk & Chantar. var. *cinereus*

1b. Fruits with long spines ..... *D. cinereus* (Radlk.) Boonsuk & Chantar. var. *echinatus* (Leenh.) Boonsuk & Chantar.

1a. Dimocarpus cinereus var. **cinereus.**

Nephelium malaiense Griff., Not. Pl. Asiat. 4: 549. 1854. *Euphoria malaiensis* (Griff.) Radlk., Actes Congr. Int. Bot., Amsterdam 1877: 95. 1879. TYPE: Malay Peninsula. Malacca: Mali, *W. Griffith KD 999* (holotype, K-000701853!; isotypes, L-0013422! [digital image], M-0224939! [digital image]).

Euphoria elongata Radlk., Actes Congr. Int. Bot., Amsterdam 1877: 95. 1879. TYPE: Borneo. Sarawak, May 1872, *O. Beccari 2459* (holotype, FI!; isotypes, K-000701863!, M-0224943! [digital image]).

Euphoria pallens Pierre, Fl. Forest. Cochinch. t. 318. 1894. TYPE: Vietnam. Bien Hua: Mt. Chiua Chang, Sep. 1865, *Pierre 4114* (lectotype, designated here, P-022973065! [digital image]; isolectotype, P-02297305! [digital image]).

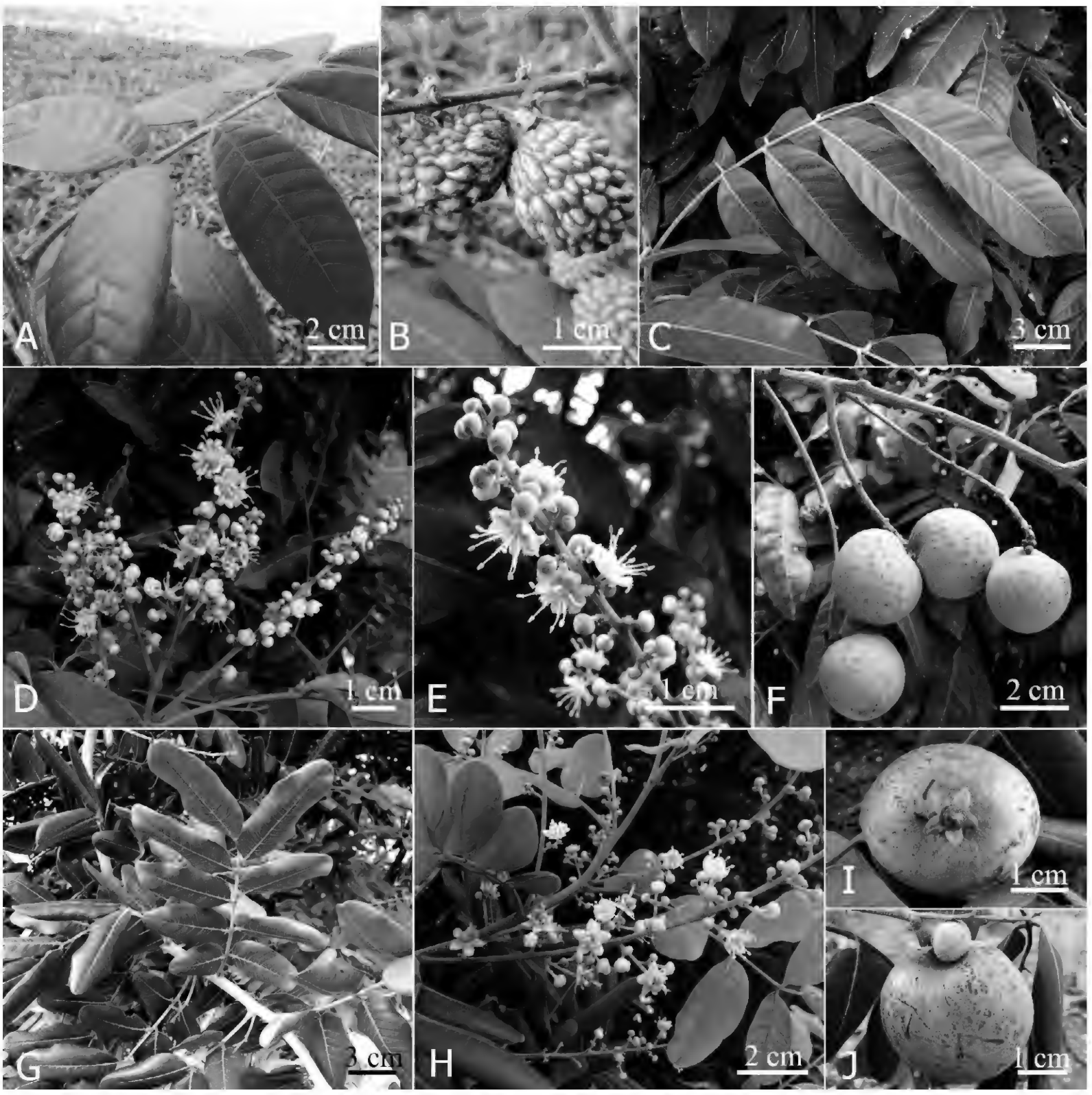

Figure 1. A, B. *Dimocarpus cinereus* (Radlk.) Boonsuk & Chantar. —A. Leaves and leaflets. —B. Fruits (immature). C–F. *Dimocarpus longan* Lour. —C. Leaves and leaflets. —D. Inflorescences. —E. Close-up of portion of an inflorescence branch. —F. Fruits (mature). G–J. *Dimocarpus scandens* (Winit & Kerr) Boonsuk & Chantar. —G. Leaves and leaflets. —H. Inflorescences. —I, J. Fruits (mature). Photos by B. Boonsuk.

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Euphoria setosa Radlk., Rec. Bot. Surv. India 3: 347. 1907. TYPE: Malay Peninsula. Perak: Larut, near Gundu Ponds, May 1885, *King's Collector 7677* (holotype, M-0224928! [digital image]; isotype, K-000701856!).

Euphoria cambodiana Lecomte, Notul. Syst. (Paris) 2: 55. 1911. TYPE: Cambodia. Kampong Speu: Prey Kdey, 19 July 1909, *Châtillon s.n.* (holotype, P-00731537! [digital image]).

Euphoria gracilis Radlk., in Elmer, Leafl. Philipp. Bot. 5: 1606. 1913. TYPE: Philippines. Mindanao: Agusan, Cabadbaran, Mt. Urdaneta, Aug. 1912, *A. D. E. Elmer 13482* (holotype, M-0224941! [digital image]; isotypes, A-00097952! [digital image], BM-000884024! [digital image], C-10018599! [digital image], FI-010508! [digital image], L-0013427! [digital image], LE-00014948! [digital image], NY-00337863! [digital image], U-1589721! [digital image], US-00095299! [digital image]).

Euphoria microcarpa Radlk., in Engler, Pflanzenr. 165: 907. 1932. TYPE: Borneo. Banguey Island, July–Sep. 1923, *P. Castro & P. Melegrito 1650* (holotype, M not seen; isotype, K-000701862!).

Dimocarpus longan subsp. *malesianus* Leenh. var. *malesianus* Leenh., Blumea 19: 126. 1971.

Discussion. *Dimocarpus cinereus* var. *cinereus* (formerly known as *D. longan* var. *malesianus*) is a

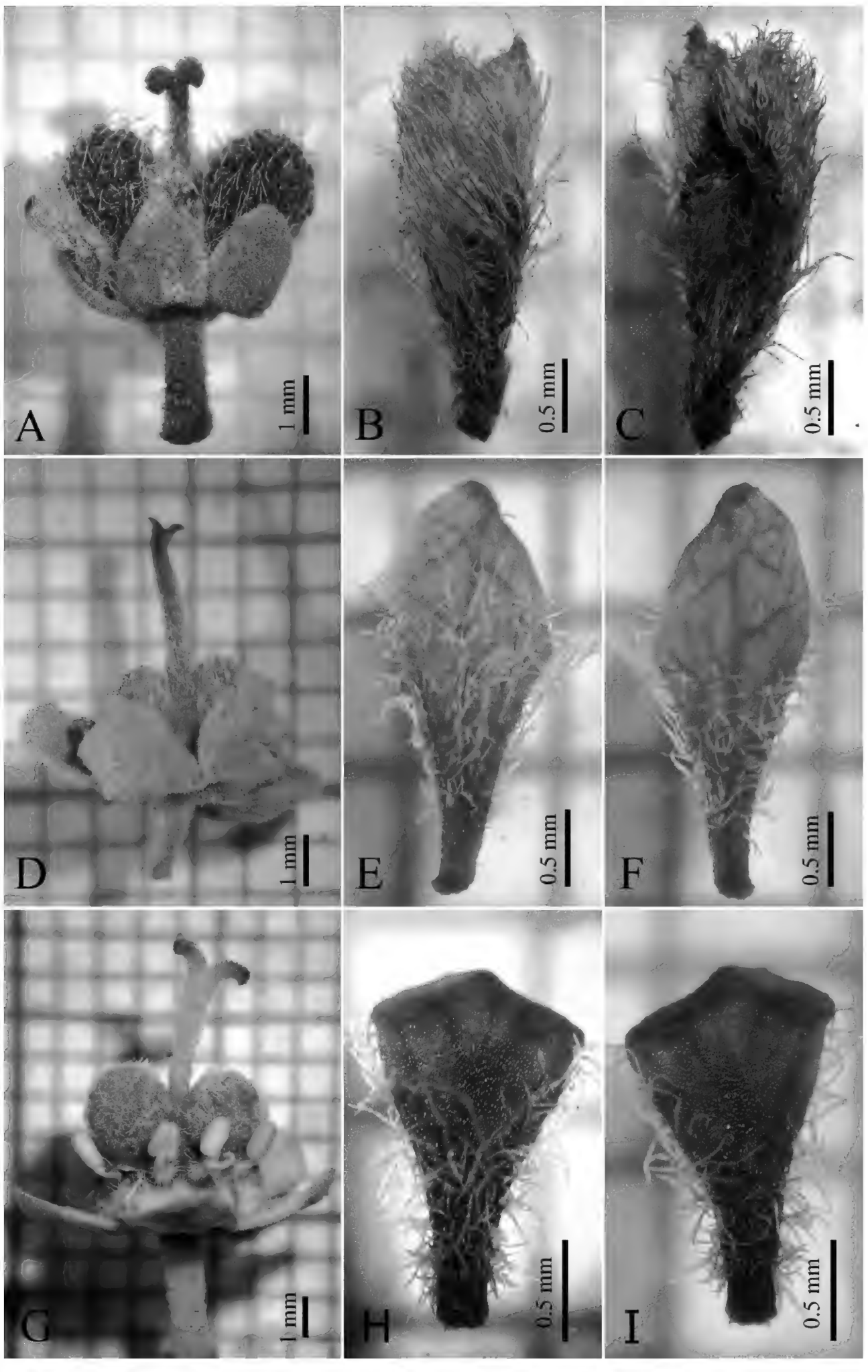

Figure 2. A–C. *Dimocarpus cinereus* (Radlk.) Boonsuk & Chantar. (from *T. & P. 668*, SING). —A. Pistillate flower, ovary with long hairs. —B. Petal with densely woolly hairs throughout (adaxial side). —C. Petal with densely woolly hairs on lower part and margin (abaxial side). D–F. *Dimocarpus longan* Lour. (from *B. Boonsuk 768*, KKU). —D. Pistillate flower, ovary with stellate hairs. —E. Petal with hairs on middle part (adaxial side). —F. Petal with hairs on lower part (abaxial side). G–I. *Dimocarpus scandens* (Winit & Kerr) Boonsuk & Chantar. (from *B. Boonsuk 767*, KKU). —G. Pistillate flower, ovary with stellate hairs. —H. Petal with hairs on middle part downward and margin (adaxial side). —I. Petal with hairs on lower part (abaxial side). Photos by B. Boonsuk.

highly variable taxon that is mainly distributed in Malesia, being a predominant taxon in the region. Leenhouts (1971) identified numerous species-level synonyms that correspond to this variety.

1b. Dimocarpus cinereus var. **echinatus** (Leenh.) Boonsuk & Chantar., comb. nov. Basionym: *Dimocarpus longan* Lour. var. *echinatus* Leenh., Blumea 19: 128. 1971. *Euphoria nephelioides* Radlk., Philipp. J. Sci., C 8: 445, 457. 1913 [1914]. TYPE: Philippines. Basilan, Aug. 1910, *W. Klemme FB 15218* (holotype, M, not seen; isotype, US-00095300! [digital image]).

Nephelium schneideri Merr., Philipp. J. Sci., C 13: 23. 1918. TYPE: Philippines. Mindanao, *Foxworthy, DeMesa & Villamil FB 13775* (holotype, probably in PNH?; isotypes, L-0013418! [digital image], K-000701849!).

Dimocarpus longan subsp. *malesianus* var. *echinatus* Leenh., Blumea 19: 128. 1971.

Discussion. *Dimocarpus longan* var. *echinatus* was described by Leenhouts (1971), who declared *Euphoria nephelioides* Radlk. to be its "basionym," indicating that it is a replacement name at a new rank for *E. nephelioides* and shares its type. We agree with Leenhouts (1971) that this taxon should be accepted at the varietal level but as a variety of *D. cinereus* rather than *D. longan*. This variety is distributed in Borneo (Sabah) and the Philippines (Basikan, Mindanao).

2. Dimocarpus scandens (Winit & Kerr) Boonsuk & Chantar., comb. nov. Basionym: *Euphoria scandens* Winit & Kerr, Bull. Misc. Inform. Kew 1941(1): 8. 1941. TYPE: Thailand. Bangkok (cultivated), *Winit s.n.* (holotype, K-000701859!; isotypes, BM-000884078!, BM-000884079!, K-000701860!, K-000701861!).

Euphoria longana Lam. var. *obtusa* Pierre, Fl. Forest. Cochinch. t. 318. 1894. *Dimocarpus longan* Lour. var. *obtusus* (Pierre) Leenh., Blumea 19: 126. 1971. TYPE: Vietnam. Cochinchina: Thu Drau Mot (cultivated), June 1865, *Pierre 4115* (holotype, P-02297311! [digital image]; isotypes, BM-000884080!, P-02297310! [digital image], P-02297312! [digital image]).

Discussion. *Dimocarpus scandens* occurs in Thailand and Vietnam and is the only taxon within the genus that is a scandent shrub and not a tree. It has been treated within the *D. longan* species complex as *D. longan* var. *obtusus*. However, the habit, leaflet apices, presence of tomentose hairs on the abaxial surface of the leaflets, petal length, and fruit surface differentiate this taxon from the typical *D. longan* (Table 1). Therefore, we raise it from a variety of *D. longan* to specific rank.

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A New Species of *Disocactus* (Cactaceae) from El Salvador

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Abstract. *Disocactus salvadorensis* Cerén, Menjívar & S. Arias is described and illustrated. This new Cactaceae species grows in the northwestern department of Santa Ana, in El Salvador. It is a member of subgenus *Disocactus* and is distinguished by its tubular and pendulous flowers with yellow or pink, less often white, tepals that are erect but recurved in the distal one third, and by its stamens in two distant whorls. Within *Disocactus* Lindl. subg. *Disocactus*, this new species is morphologically most similar to *D. eichlamii* (Weing.) Britton & Rose and *D. quezaltecus* (Standl. & Steyerm.) Kimnach. Distribution and ecological information about the new species are provided.

Resumen. Se describe e ilustra *Disocactus salvadorensis* Cerén, Menjívar & S. Arias. Esta nueva especie de Cactaceae se conoce del Departamento de Santa Ana, en el noroeste de El Salvador. Es un miembro del subgénero *Disocactus*; se distingue por presentar flores tubulares y péndulas, tépalos erectos y recurvados en el tercio superior, amarillos o rosas, pero con menos frecuencia blancos, estambres en dos series distantes. Dentro de *Disocactus* Lindl. subg. *Disocactus*, la especie nueva tiene una similitud morfológica con *D. eichlamii* (Weing.) Britton & Rose y *D. quezaltecus* (Standl. & Steyerm.) Kimnach. Adicionalmente se presenta información sobre la distribución y datos ecológicos de la nueva especie.

Key words: Cactaceae, *Disocactus*, El Salvador.

Disocactus Lindl. is a genus in the family Cactaceae, subfamily Cactoideae, tribe Hylocereeae. As currently circumscribed, *Disocactus* includes 15 species of climbers or epiphytes. The stems have ribs or phylloclades; the flowers are diurnal and colorful (yellow to red) or nocturnal and white, and may be funnelform or tubular. The stamens arise in one or two series; the fruit is naked or bears few spines; and the seeds are 1.6–2.4 mm long and black to brown (Barthlott, 1991a; Bauer, 2003; Hunt et al., 2006; Cruz et al., 2016). The first detailed taxonomic revision of *Disocactus* was conducted by Kimnach (1993), who recognized 12 species divided into four sections: *Disocactus*, *Macranthi* Kimnach, *Pseudorhipsalis* (Britton & Rose) Kimnach, and *Wittia* (K. Schum.) Kimnach. The second revision was performed by Barthlott (1991a, 1991b) and was accepted in taxonomic syntheses by Hunt et al. (2006) for the family and by Bauer (2002, 2003) for Hylocereeae. These taxonomic summaries exclude *Pseudorhipsalis* Britton & Rose as a subgenus, but include the subgenera *Aporocactus* (Lem.) Barthlott, *Ackermannia* (K. Schum.) Barthlott, *Nopalxochia* (Britton & Rose) Barthlott, and *Disocactus*. A study to determine the phylogenetic relationships of the genus was conducted by Cruz et al. (2016), supporting the exclusion of *Disocactus* subg. *Aporocactus*, a strong relationship with *Epiphyllum* Haw. and *Pseudorhipsalis*, and demonstrating that *Disocactus* is more heterogeneous in its morphology than previous taxonomic syntheses had indicated. Based on this phylogenetic analysis, *Disocactus* includes 15 species native to Mexico, Guatemala, Honduras, El Salvador, Nicaragua, and Costa Rica, where they inhabit tropical montane cloud regions (Stadtmüller, 1987; Gual-Díaz & Rendón-Correa, 2014). *Disocactus* species have diurnal flowers (except for *D. crenatus* (Lindl.) M. Á. Cruz & S. Arias), berrylike fruits with ovoid seeds, and a preference for montane rainforest habitats.

Eight species of *Disocactus* are known from Guatemala, Honduras, and El Salvador: *D. biformis* (Lindl.) Lindl., *D. eichlamii* (Weing.) Britton & Rose, *D. quezaltecus* (Standl. & Steyerm.) Kimnach, *D. nelsonii* (Britton & Rose) Linding., *D. aurantiacus* (Kimnach) Barthlott, *D. lodei* Véliz, L. Velásquez & R. Puente, *D. speciosus* (Cav.) Barthlott, and *D. crenatus* (Cruz et al., 2016). The first three are native to Guatemala at altitudes between 1000 and 2200 m above sea level; references to the presence of *D. biformis* in Honduras (Bravo-Hollis, 1978; Véliz, 2008) result from geographical confusion, while those

in El Salvador (Bauer, 2003) and Costa Rica (Rivas, 1998) are misidentifications. *Disocactus lodei*, also native to Guatemala, has been collected from about 1060 m. *Disocactus nelsonii* grows from Mexico (Chiapas) to Honduras (Comayagua) at altitudes between 1000 and 2300 m, while *D. aurantiacus* grows from El Salvador (Santa Ana) to Nicaragua (Jinotega) between 1500 and 2200 m, and *D. speciosus* and *D. crenatus* are found from Mexico to Honduras and Nicaragua at altitudes below 1800 m (Bauer, 2003; Cruz et al., 2016).

Since 2011, a team of investigators from the Museo de Historia Natural de El Salvador (MHES) has carried out explorations to better understand the flora, with a particular emphasis on the project "Cactus Diversity in El Salvador and its Contributions to National Development," carried out in conjunction with the Universidad Nacional Autónoma de México (UNAM) Instituto de Biología. The team found a well-preserved population of cactus species in Montecristo National Park in Santa Ana, growing in the range of 1439–2209 m. It was compared with the above-mentioned species of *Disocactus* to confirm that it is a different and new species, described below.

Disocactus salvadorensis Cerén, Menjívar & S. Arias, sp. nov. TYPE: El Salvador. Santa Ana: Mpio. Metapán, Parque Nacional Montecristo, 14°23′59″N, 89°21′39″W, 1822 m, 28 Mar. 2012, *J. Menjívar, S. Arias, G. Cerén, G. N. López & F. Magaña 2432* (holotype, MHES!; isotypes, MEXU!, MO!). Figures 1, 2.

Haec species *Disocacti eichlamii* (Weing.) Britton & Rose et *D. quezalteci* (Standl. & Steyerm.) Kimnach quoad flores tubulares similis, sed a hoc floribus rectis tubo receptaculari et tepalis subaequalibus, ab illo tepalis externis internisque in tertia parte apicali tantum recurvatis, ab ambobus floribus pendulis e caulibus suberectis vel pendulis surgentibus atque tepalis plerumque flavis, raro roseolis vel albidis sed semper concoloribus differt.

Plant forming a large shrub; stems initially ascending and then pendent, differentiated into primary, secondary, and occasionally tertiary stems; primary stems cylindrical for up to 1.5 m, then as phylloclades for up to 100 × 1.5–3 cm; secondary stems from the upper cylindrical section and from the phylloclades of the primary stems, cylindrical for up to 30–60(–100) × 1–3 cm, the phylloclades up to 24 × 1–3.3(–9) cm; tertiary stems, if present, arising from phylloclades of the secondary stems; phylloclades of all orders fleshy (up to 3 mm thick), linear-lanceolate, the margin obtusely serrate, variable, the lobes projecting up to 3 mm, deep green; areoles (0.5–)1–3.2(–5) cm apart, with bristles present in seedling, absent in adult stems. Flowers 1 per areole, (6.8–)7.3–9(–9.6) × 1–2.5(–3.3) cm at anthesis, tubular, straight and pendulous on erect or pendent stems; pericarpel 0.5–0.9 × 0.2–0.3 cm, globular, receptacular tube 2.5–3.5(–4.2) cm, 2.5–4 mm wide at the base of the tube, 3–8(–11) mm wide in the throat, greenish in the pericarpel to pale pink in the receptacular tube, the podaria inconspicuous, the areoles with trichomes at the base of pericarpel, naked in the rest of pericarpel and tube, the scales up to 3 × 1 mm, accrescent, deltoid, green, sometimes red or yellow; outer tepals 3 to 5, 2.3–3.5 × 0.2–0.5 cm, erect, with apices recurved, linear-lanceolate, acute, yellow, sometimes pink, but occasionally white; inner tepals 3 to 4, 2.5–3.5 × 0.3–0.9 cm, erect, with apices recurved, lanceolate, acute, yellow, sometimes pink, but occasionally white; nectarial chamber in lower part of tube, 0.8–2 cm; stamens 25 to 30, 2–4.1 cm, exserted up to 1.2 cm, attached in two series, the lower inserted up to 1.3 mm above the nectarial chamber, the upper inserted at the apex of the tube, all filaments white, the anthers ca. 1 mm, pink or white; style 5–8.3(–9) cm, exserted, white, rarely pink, the stigma lobes 4 or 5, 2–4 mm, yellow, pink, or rarely white. Fruit 1–1.5 × 0.6–1 cm, ovoid, red, the scales up to 1 mm, green, with the margin becoming pale brown when ripe, pulp pink; seeds 1.5–2 × 1 mm, broadly ovoid, glossy black, smooth, with the cell walls straight, interstices appearing only occasionally in the ventral region, hilum-micropylar region ellipsoid.

Phenology. *Disocactus salvadorensis* flowers in March and April, while fruiting occurs in July.

Distribution and habitat. Populations of *Disocactus salvadorensis* are found in Montecristo National Park, located in the northeastern section of the department of Santa Ana. It grows as an epiphyte on different tree species, most frequently on *Olmediella betschleriana* (Göpp.) Loes. (morro de montaña), *Ficus* L. spp. (amate), and *Sapium* Jacq. spp. (chilamatillo), in the altitudinal strip of tropical cloud forest and the area transitioning into pine-oak forest, at elevations between 1439 and 2209 m. In terms of known species of *Disocactus* from El Salvador, a recent floristic study of the country's Cactaceae documents the presence of *D. speciosus*, *D. aurantiacus*, and this new species (Cerén et al., 2015). However, *D. eichlamii*—found only in the department of Santa Rosa, Guatemala—is the member of the genus geographically closest to the new species (Kimnach, 1993).

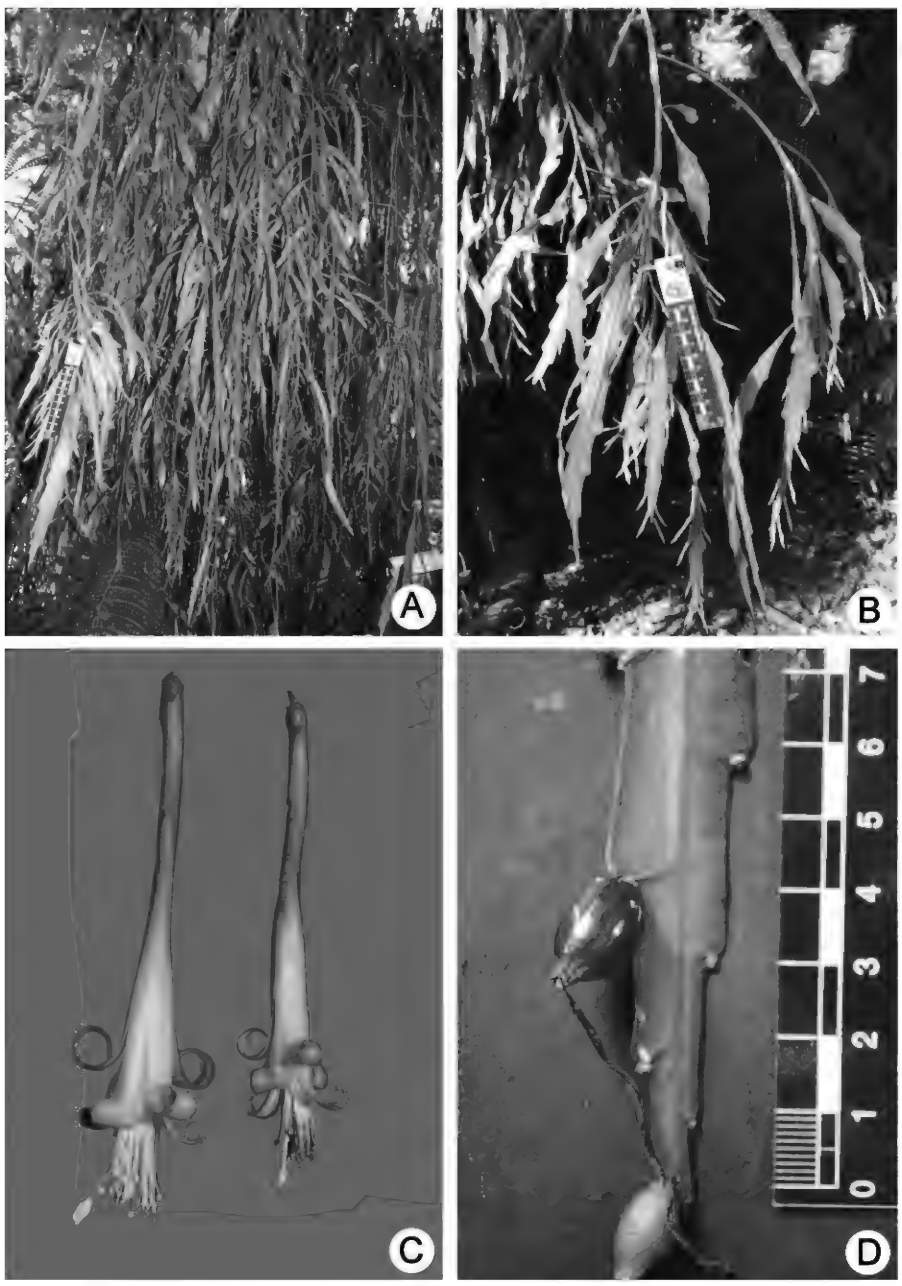

Figure 1. *Disocactus salvadorensis* Cerén, Menjívar & S. Arias. —A. Habit (*J. Menjívar et al. 2432*, MHES). —B. Stems (*J. Menjívar et al. 2432*, MHES). —C. Flowers in side view (*J. Menjívar et al. 2432*, MHES). —D. Fruit (*G. Cerén et al. 2578*, MHES).

Etymology. The specific epithet of *Disocactus salvadorensis* refers to El Salvador, the country where the plant was found.

Discussion. *Disocactus salvadorensis* is clearly a member of the genus *Disocactus*, whose included species display variation in a number of important morphological characters (Hunt et al., 2006; Cruz et al., 2016). These characters include a growth habit of epiphytic or epilithic shrubs; branches flattened, triangular, or up to 8-ribbed, with spines or bristles or unarmed; flowers 4.5–20 cm long; stamens in two or a single series (*D. biformis*); and seeds 1.5–2.5 mm long, ranging from brown to black.

Disocactus salvadorensis is morphologically similar to *D. biformis*, *D. eichlamii*, and *D. quezaltecus*, all

Figure 2. Seed morphology of *Disocactus salvadorensis* Cerén, Menjívar & S. Arias. —A. Lateral view. —B. Hilum-micropylar region. —C. Close up of the surface texture (lateral view).

Table 1. Comparison of morphological characters between four species of *Disocactus* Lindl. subg. *Disocactus*.

	*D. biformis** (Lindl.) Lindl.	*D. eichlamii** (Weing.) Britton & Rose	*D. quezaltecus** (Standl. & Steyerm.) Kimnach	*D. salvadorensis* Cerén, Menjívar & S. Arias
Phylloclade of secondary stem size (cm)	< 12 × 1–2.6	< 40 × 1.5–5	< 45 × 1.5–5.5	< 24 × 1–3.3(–9)
Flower size (cm)	4.5–6 × 3–4	6–8 × ca. 1	8–9 × ca. 1	(6.8–)7.3–9(–9.6) × 1–2.5(–3.3)
Flower shape	funnelform	tubular	tubular	tubular
Flower orientation on pendent stems	curved upward	horizontal or curved upward	horizontal or curved steeply upward	straight and pendulous
Outer tepal expansion	expanded at the base	erect, recurved in the apical half	erect, appressed to inner tepals	erect, recurved in the apical third
Inner tepal expansion	recurved in the apical half	recurved in the apical half	appressed to the stamens	recurved in the apical third
Inner tepal color	pink-purplish	magenta-scarlet	pinkish white	yellow, pink, occasionally white
Receptacular tube length (cm)	1.8–2.1	ca. 3	ca. 5	2.5–3.5(–4.2)
Stamen length (cm)	2–2.6	ca. 4	ca. 4	2–4.1
Stamen position	included	exserted	exserted	exserted
Stamen arrangement	in a single series	in two series	in two series	in two series

* Data obtained from Kimnach (1993) and Bauer (2003).

endemic to Guatemala. It differs markedly from the first by its more tubular (vs. funnel-shaped) flowers and by its stamens attached in two (vs. one) series. The new species resembles the latter two more because they share relatively tubular flowers with exserted stamens attached in two series (Table 1). Of those two, the new species seems most similar to *D. eichlamii*, with which it shares flowers with the receptacular tube and tepals of about equal length, and with up to ca. 30 stamens (vs. the receptacular tube one half the length of the tepals, and with 41 to 47 stamens in *D. quezaltecus*). Perhaps the most obvious character that distinguishes *D. salvadorensis* from *D. eichlamii* are its tepals, which are recurved in the distal one third (vs. recurved in the distal one half). Furthermore, its flowers are straight and pendulous, whether arising from suberect or pendent stems. Kimnach (1993) noticed that the variation in the degree of curvature on the flower in *D. eichlamii* and *D. quezaltecus* is related to its development in suberect or pendent stems, causing straight (horizontal) or curved (ascending) flowers respectively. Other notable differences include the apex expansion of the outer and inner tepals and their color (Table 1). The observed variation in the tepal color of *D. salvadorensis* is significant, as there are no other reports of wide variation in the color of the flower within species in *Disocactus*. Most individuals have yellow flowers, but a smaller percentage are pink, or even white (Fig. 3). The latter case may not exceed one tenth of the flowers observed in the population of Montecristo National Park. However, the color is uniform on the tepals' surface, unlike other species, in which two or more tones are present between the faces or tepal sections, e.g., *D. nelsonii* (greenish yellow or yellowish purple on the outside and pink on the inside).

A phylogenetic analysis by Cruz et al. (2016) of *Disocactus* using six chloroplast markers reveals that there is a close relationship between the new species and *D. eichlamii* and *D. quezaltecus*, but not *D. biformis*. Morphologically, *D. salvadorensis* differs from *D. biformis* in terms of the form and orientation of the flower in anthesis, the exserted position and the presence of two separate series of stamens, and the expansion and color of tepals (Table 1). The funnelform flower is typical of *D. biformis*, with a significant reduction in the receptacular tube (1.8–2.1 cm long) and the expansion of the outer tepals almost from the base. In contrast, *D. salvadorensis* has a straight and tubular flower, and the tepals are erect and recurved only in the apical one third (Fig. 1).

Figure 3. *Disocactus salvadorensis* Cerén, Menjívar & S. Arias, flowers. A–C. Color variation. —A. Yellow (*G. Cerén et al. 2578*, MHES). —B. Pink (*J. Menjívar et al. 2428*, MHES). —C. White (*G. Cerén et al. 3330*, MHES). —D. Longitudinal section (*G. Cerén et al. 2882*, MHES).

Paratypes. EL SALVADOR. **Santa Ana:** Metapán, Parque Nacional Montecristo, Enganche a sendero el huyo, 26 abr. 2012. *A. R. López 1* (MHES); Enganche a sendero del huyo, 27 mar. 2012, *G. Cerén, S. Arias, J. Menjívar, G. N. López & F. Magaña 2578*, *2579*, *2581* (MHES); La Hondurona, 5 jul. 2007, *G. Cerén, A. Quesada & O. García 1594* (MHES); La Hondurona, 1 mayo 2014, *G. Cerén, J. Menjívar & F. Magaña 3330* (MHES); La Hondurona, 6 jul. 2007, *J. Menjívar, J. F. Morales & V. Corea 1408* (MHES); 400 m debajo de la vuelta del cadejo, 28 mar. 2012, *J. Menjívar, S. Arias, G. Cerén, G. N. López & F. Magaña 2428* (MHES); Jardín de los Cien Años, 28 mar. 2012, *J. Menjívar, S. Arias, G. Cerén, G. N. López & F. Magaña 2430* (MHES); Jardín de los Cien Años, 7 jul. 2014, *G. Cerén 3328* (MHES); sobre sendero el Huyo, 14 abr. 2013, *J. Menjívar, G. N. López, F. Magaña & R. Gregorio 2870*, *2871*, *2872*, *2873*, *2882* (MHES); Quebrada el Torero, 27 mar. 2014 (fl.), *J. Menjívar, G. Cerén & F. Magaña 3117*, *3118*, *3119* (MHES); Montecristo, 3 abr. 1979, *M. L. Reyna 1200* (MHES); Los Descombros, 26 mar. 2003, *R. A. Carballo & E. O. Ramos 694* (LAGU); camino al Trifinio, 26 mayo 2003, *R. A. Carballo & E. O. Ramos 719* (LAGU); El Plan del Atajo, 17 mar. 2002, *V. M. Martínez 830* (LAGU); Miramundo, 3 abr. 2002, *V. M. Martínez 883* (LAGU); Miramundo, 1 mayo 2002, *V. M. Martínez 1016* (LAGU); Cerro Montecristo W side, 1998, *B. Vollmer 9997-98* (ZSS).

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A New Species of *Wettinia* (Arecaceae: Arecoideae: Iriarteeae) from Panama

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Abstract. A new species of Arecaceae, *Wettinia donosoensis* De Gracia & Grayum, from the Atlantic slope of Panama, is described and illustrated. It is readily distinguished from all other species of *Wettinia* Poepp. by the combination of small size (3–5 m); leaves with few (usually six or seven per side) pinnae; unbranched, lax inflorescences; and very long petals (in pistillate flowers, 25–30 mm). It is endemic to a small region in Donoso District, Colón Province, and its conservation status is assessed as Endangered.

Key words: Arecaceae, Colón, Donoso, Panama, taxonomy, *Wettinia*.

The new species of *Wettinia* Poepp. (Arecaceae: Arecoideae: Iriarteeae) described in this paper was discovered during botanical inventory work in Donoso District, westernmost Colón Province, Panama, on the site of a large copper-mining concession administered by Minera Panamá S.A. While this region had been poorly botanized, adjacent areas to the west, south, and east have been relatively well collected. Thus it has come as somewhat of a revelation that the Donoso region harbors a rich and distinctive flora that, in the past decade, has yielded more than 20 previously undescribed species of vascular plants in families including Acanthaceae, Annonaceae, Araliaceae, Burseraceae, Gesneriaceae, Lauraceae, Loganiaceae, Marantaceae, Melastomataceae, Myrtaceae, and Rubiaceae (see Schatz et al. [2015] for a partial list). Additionally, many country records and other range extensions have now been documented for Donoso.

The palm flora of Donoso, in the humid lowlands of the Atlantic slope, is particularly diverse. An unpublished, largely vouchered list we maintain for the copper-mining site (which ranges in elevation from sea level to 431 m) enumerates 45 species, including two in the genus *Wettinia*: *W. quinaria* (O. F. Cook & Doyle) Burret (including *W. panamensis* R. Bernal; cf. Correa A. et al., 2004), widespread throughout Panama (and into South America), and the species described here as new, which seems to be a local endemic. *Wettinia*, with ca. 20 species (Govaerts et al., 2016), ranges from Panama through Colombia, Peru, Ecuador, and Bolivia, and into western Brazil. The greatest diversity is found in Colombia, to the west of the Andes and especially in the area of the Chocó (Henderson, 1995; Dransfield et al., 2008; Galeano & Bernal, 2010), while three species have been attributed to Panama (Correa A. et al., 2004), at the northern distributional limit of the genus. *Wettinia* is easily distinguished morphologically among New World palms by the combination of stems with stilt roots, pinnate leaves with the pinnae praemorse at the apex, unisexual flowers, staminate and pistillate flowers borne in separate inflorescences that are generally multiple at the nodes (i.e., the plants are monoecious), and hairy and/or warty or spiny (but never scaly) fruits.

Wettinia has never been the subject of a proper taxonomic revision, which makes work on the genus somewhat difficult; however, contributions by Moore and Dransfield (1978), Bernal (1995), and Galeano and Bernal (2010) provide significant inroads. Species distinctions in *Wettinia* are based on several

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morphological characters, including growth habit, leaf architecture, number of inflorescences per node, inflorescence branching, length of the sepals and petals, density of the infructescences, and features of the fruit surface (Moore & Dransfield, 1978; Henderson, 1995; Galeano & Bernal, 2010). The new species described in this paper was first collected by the second author in the Donoso region in 2014. This intriguing material bore only very young inflorescence buds, but was provisionally identified as belonging to *Wettinia* by virtue of its praemorse pinnae and multiple inflorescences; subsequent herbarium study suggested that it could well represent an undescribed species. Both hypotheses were borne out by critical examination of much better material obtained the following year by the first author in the same region, enabling the following presentation.

Wettinia donosoensis De Gracia & Grayum, sp. nov. TYPE: Panama. Colón: Donoso, San Juan del General, Concesión del Proyecto Mina de Cobre Panamá, Río Botija, bosque secundario maduro, 8°49′38″N, 80°38′58″W, 110 m, 14 May 2015 (fr.), *J. De Gracia, I. Vergara-Pérez & L. Rojas 882* (holotype, PMA!; isotype, MO [single specimen mounted on three sheets plus a separate dried infructescence: MO-6172294, MO-6660314, MO-6660315, MO-6660316]!). Figures 1, 2.

Diagnosis. Uniquely characterized among its congeners by the combination of small size (3–5 m); leaves with few (usually six or seven per side) pinnae; unbranched, lax inflorescences; and pistillate flowers with long (25–30 mm) petals, in the last respect comparable only to the South American *Wettinia longipetala* A. H. Gentry, which differs in its larger size (5–15 m), larger leaves with much more numerous pinnae (ca. 30 to 45 per side), and larger fruits.

Treelets, the stems caespitose or (rarely) solitary, 3–5 m tall, 4–5 cm diam., brown, smooth, ringed; stilt roots 0.2–0.4 m tall, 1.5–2.5 cm diam., brown, prickly. Leaves 5 to 7; sheaths 30–40 cm, with ligule ca. 10 × 1–1.5 cm, with reddish brown, bulbous-based trichomes; petiole 27–43 cm, ca. 1 cm diam.; rachis 64–109 cm, subterete; pinnae 6 or 7(8) per side, alternate, regularly arranged and in 1 plane, undivided, narrowly rhombic, praemorse at apex, puberulous below with reddish brown, flat trichomes; proximal pinnae 10–25 × 5–6.5 cm, with 14 or 15 veins; medial pinnae 26–39 × 10–12 cm, with ca. 16 veins; terminal pinna 22–28 × 16–24 cm, flabellate, acuminate to caudate at apex (the acumen ca. 1–3 cm), with ca. 32 veins. Inflorescences infrafoliar, 3 to 5 per node, spicate, unisexual, the central usually pistillate, the lateral staminate; prophyll ca. 2 cm, tubular, bicarinate, with simple trichomes; peduncle 7–10.5 cm, decurved, with reddish brown, bulbous-based trichomes; peduncular bracts 4, the 2 proximal 4–7.5 cm and tubular, the 2 distal 11–18 cm and cucullate, all bearing simple trichomes; rachis 11–22 cm. Staminate flowers with sepals ca. 2 × 1 mm, triangular; petals ca. 23 × 2 mm, linear, longitudinally striate; stamens 3 to 6, filaments ca. 2 mm, anthers basifixed, ca. 9 mm, acuminate at apex (the acumen ca. 2 mm). Pistillate flowers (post-anthesis) with sepals 2–2.5 mm, triangular; petals 25–30 × 2–3 mm, linear, longitudinally striate. Fruits chocolate brown, 2.5–3 × 1–1.2 cm, ovate-elliptic, densely brown-hispidulous with bulbous-based and filamentous trichomes, with a persistent style; seed cream, ca. 17 × 9 mm, ovoid.

Distribution and phenology. *Wettinia donosoensis* De Gracia & Grayum is endemic to Panama, known from just five collections from the basin of the Río Botija, District of Donoso, Colón Province, in lowland tropical rainforest at elevations below 150 m; plants have been found with inflorescences in young bud in late August, flowers in October, and mature (or nearly mature) fruits in April and May.

IUCN Red List category. *Wettinia donosoensis* De Gracia & Grayum is thus far known to have an extremely restricted geographic range in the form of an extent of occurrence (EOO) and area of occupancy (AOO) of only 2.37711 km^2. However, with respect to the threat from mining, there are two locations, insofar as some individuals occur on the mine footprint whereas others occur immediately adjacent to the mine footprint. The total population size is estimated to be less than 2500 mature individuals, all of which occur within a single subpopulation. Thus, with continuing decline projected as a result of mining activities, the risk of extinction can be assessed as Endangered (EN): B1ab(i,ii,iii,iv,v)+2ab(i,ii,iii,iv,v); C2a(ii), with projected decline in the EOO, AOO, quality of habitat, number of mature individuals, and number of locations (IUCN, 2012).

Etymology. The specific epithet refers to the District of Donoso (Colón Province, Panama).

Discussion. *Wettinia donosoensis* is distinctive by virtue of its comparatively small and slender habit, leaves with few (usually six or seven) pinnae per side, unbranched, lax inflorescences, and pistillate flowers with long petals (25–30 mm), a

Figure 1. *Wettinia donosoensis* De Gracia & Grayum (*Grayum et al. 13262*, MO, PMA). Leaves (center and lower left). Photo by Christel Ramos.

combination of characters not found in any other species of the genus. The new species resembles *W. drudei* (O. F. Cook & Doyle) A. J. Hend., from Amazonian lowland forests, in its small habit, leaf architecture, and fruit indumentum; however, the latter species has branched inflorescences, pistillate flowers with much shorter petals (ca. 4.5 mm), and smaller fruits (Henderson, 1995; Galeano & Bernal, 2010). The Ecuadorian *W. minima* R. Bernal is another species with a similarly small habit, but differs in having leaves with the pinnae longitudinally divided, branched inflorescences, pistillate flowers with much shorter petals (3–4 mm), and smaller fruits (Bernal, 1995). The aptly named *W. longipetala* A. H. Gentry, of Ecuador and Peru, has pistillate flowers with petals of similar length to those of *W. donosoensis*, as well as unbranched inflorescences. Gentry (1986: 161) characterized *W. longipetala* as having the petals of its pistillate flowers "much longer than in any other species of the genus and at least twice as long as in any of the related single-spiked species." Only four new *Wettinia* species have been described since that time, all by Bernal (1995), and none of these provides any basis for contravening or modifying Gentry's statement. Its spicate inflorescences and relatively crowded, densely hispidulous fruits suffice to separate *W. donosoensis* from species that had been assigned to the genus *Catoblastus* H. Wendl., not within Gentry's purview, but later submerged in *Wettinia* by Bernal (1995). Thus, the most meaningful comparison for our new species is with *W. longipetala*, which differs, inter alia, in its solitary habit; larger size (5–15 m, according to label data); larger leaves (200–400 cm) with much more numerous (ca. 30 to 45 per side), longer (to ca. 50 cm), and proportionately narrower pinnae; and larger (to ca. 3.5 × 3 cm), obconical fruits that are more densely compacted on the infructescence rachis.

Paratypes. PANAMA. **Colón**: Botija, entrando por camino corto, Río Botija, 8°50′05.4″N, 80°38′39.9″W, 108 m, 11 Apr. 2016 (fr.), *J. Batista, L. Rojas & E. González 1572* (MO, PMA); San Juan del General, Concesión del Proyecto Mina de Cobre Panamá, Río Botija, 8°49′35″N, 80°36′20″W, 102 m, 10 Oct. 2015 (fl. ♂), *J. De Gracia &*

Figure 2. Photographs of the type collection of *Wettinia donosoensis* De Gracia & Grayum (*De Gracia et al. 882*, MO, PMA). —A. Habit, with leaves and infructescences. —B. Stilt roots. —C. Infructescences at various stages of development (most mature at left). Scale bar in C = 10 cm.

L. Rojas 891 (PMA); San Juan del General, Concesión del Proyecto Mina de Cobre Panamá, Río Botija, bosque secundario maduro, 8°49′32″N, 80°37′22″W, 90 m, 6 May 2015 (fr.), *J. De Gracia & I. Vergara-Pérez 879* (MO, PMA); Minera Panamá copper-mining concession, along Río Botija and tributary creeks, 8°50′01″N, 80°38′40″W, 136 m, 31 Aug. 2014 (bud), *M. H. Grayum, G. McPherson, C. Ramos, S. Castillo & L. Rojas 13262* (MO, PMA).

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Remarks on the Typification of the Linnaean Name *Platanus occidentalis* (Platanaceae)

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Abstract. Some aspects concerning the typification of *Platanus occidentalis* L. (Platanaceae) are discussed. This name had been typified previously by Reveal in 2009 from a specimen kept at LINN. However, it is unclear whether this specimen is part of Linnaeus's original material so it cannot be considered a lectotype. A specimen conserved in the Linnean Herbarium Herb. Linn. No. 388.17 (S-LINN) is designated here as the lectotype of the name *P. occidentalis*.

Key words: Lectotype, Linnaeus, nomenclature, Platanaceae, *Platanus*.

The genus *Platanus* L. (Platanaceae) occurs naturally only in the northern hemisphere and comprises nine species, which often spontaneously hybridize when brought into cultivation (Ernst, 1963; Kaul, 1997; Nixon & Poole, 2003). Six species (and several varieties) occur in North America from northern California and the eastern United States to southern Mexico and adjacent Guatemala (*P. gentryi* Nixon & J. M. Poole, *P. mexicana* Moric., *P. occidentalis* L., *P. racemosa* Nutt., *P. rzedowskii* Nixon & J. M. Poole, and *P. wrightii* S. Watson). Three species are usually recognized in the Old World: one species in southern Europe and the Middle East (*P. orientalis* L.), a second species (*P. acerifolia* (Aiton) Willd.) of uncertain origin and taxonomic status (probably a hybrid between *P. occidentalis* and *P. orientalis*, or a cultivar of *P. orientalis*; see Henry & Flood, 1919; López González, 1998), and one apparently relictual species in Laos and North Vietnam (*P. kerrii* Gagnep.) (Tutin & Edmondson, 1964; Kaul, 1997; Nixon & Poole, 2003).

Platanus occidentalis is distributed in the eastern United States and is cultivated as a shade tree in many regions of the world. This species is a tree up to 50 m tall, with stipulate leaves, stipules that are light green, usually shallowly 3- to 5(to 7)-lobed, occasionally unlobed, with the terminal leaf lobe 1/2 to 2/3 the length of the blade; the leaf margins are entire to coarsely serrate, with sometimes short-awned teeth, the apex usually acuminate, and both surfaces glabrate, except often persistently tomentose along veins abaxially (Kaul, 1997; Nixon & Poole, 2003).

Linnaeus published two species names in the genus *Platanus* (Linnaeus, 1753). However, the Linnaean name *P. occidentalis* (1753: 999) appears to be as yet untypified (see Jarvis, 2007: 749–750), and it is here investigated. Nixon and Poole (2003: 133) had previously attempted to typify this name using a specimen held at LINN, as "(HOLOTYPE: LINN, photograph of holotype as IDC microfiche 1133-5)." Jarvis (2007: 749–750) and Reveal (2009: 301) observed that this statement was published after 1 January 2001, and omitted the phrase "designated here" or an equivalent (as required by Art. 7.10 of the International Code of Nomenclature; McNeill & al., 2012) and therefore this type choice is ineffective. Later, Reveal (2009: 301), following Nixon and Poole, designated the same specimen at LINN (Herb. Linn. No. 1133.5) as a lectotype.

Herb. Linn. No. 1133.5 (image available at <http://linnean-online.org/11748/>) bears a well-preserved fragment, with leaves and fruits, and is annotated "*Platanus*" and "*occidentalis*" by Linnaeus. The sheet also bears a label "471 / *Platanus occidentalis* aut. *virginiensis* / stbys. park. th. 1427 / 471" written by Johan Fredrik Gronovius. However, this sheet lacks the relevant Linnaean species number in the *Species Plantarum*, in this case the number "2." In general, Linnaean specimens that bear these numbers usually were in Linnaeus's possession before the publication of *Species Plantarum* and were original material for names in that work, whereas most specimens that lack numbers were not (see, e.g., Stearn, 1957; Turland & Jarvis, 1997; Turland, 2006; Jarvis, 2007: 41–46). In consequence, Herb. Linn. no. 1133.5 cannot be presumed to be original material, and therefore the designation by Reveal (2009: 301) is not in conformity with Article 9.2 of the ICN. By contrast, this Linnaean species number "2" appears on other herbarium specimens of *P. occidentalis* in the Linnaean collections (e.g., at BM and S-LINN) that

have been considered as Linnaeus's original material herein and by Jarvis (2007: 749).

The purpose of this paper is to contribute to the stability of nomenclature by the lectotypification of this name. The designation of the lectotype is based on the consultation of Linnaeus's original material and the literature cited in the protologue.

Lectotypification. Linnaeus's protologue (Linnaeus 1753: 999) consists of a nomen specificum legitimum, "PLATANUS foliis lobatis," quoted from an earlier Linnaean work (Linnaeus 1738: 78) and two other works, by Gronovius (1739: 119) and Van Royen (1740: 206), followed by two synonyms. The protologue also includes "*Habitat in* America septentrionalis" as the geographical locality. The first synonym, "Platanus occidentalis," was cited from Catesby (1730: 56, t. 56), and the second synonym, "Platanus occidentalis f. virginiensis," from Parkinson (1640: 1427). The protologue also includes the comment "*Confer*. Platanus orientalis. Pock. itin. 2. t. 89." Two illustrations, provided by Catesby (1730: t. 56) and Parkinson (1640: 1427), are considered original material.

Moreover, there is herbarium material that serves as vouchers for Catesby's illustration: Herb. Sloane 212: 68 (BM–SL). This material was not studied by Linnaeus and so is not part of the original material for the Linnaean name (see Jarvis, 2007: 749). However, herbarium material such as this can be of assistance in interpreting Catesby's illustrations (which were used by Linnaeus) and may be considered as "typotype or voucher specimen" material if it is clear that the illustration was originally prepared from it. Howard and Staples (1983), Wilbur (1990), and Reveal (2009) provided identifications for almost all of the plates, also correlating with them the extant material collected by Catesby (now in Herb. Sloane at BM–SL, and OXF) (see also Harris, 2015) and identified Catesby's plate as *Platanus occidentalis*.

Among Linnaeus's original material, two herbarium sheets are found. In the Clifford herbarium at BM there is a herbarium sheet with Linnaeus's original material, the sheet Herb. Clifford: 447, *Platanus* 2 (BM, barcode BM000647416), bearing a well-preserved fragment with leaves. It is annotated "Platanus occidentalis, aut virginensis" with the number "2" on the sheet (image available at <http://data.nhm.ac.uk/object/2c329d7c-1340-49bb-b063-1adbed903949>).

Finally, in the Linnean herbarium at S there is a sheet with original material, Herb. Linn. No. 388.17 (S-LINN) (image available at <http://linnaeus.nrm.se/botany/fbo/p/plata/platocc.html.en>), the sheet bearing a fragment with leaves and fruits, and annotated "Platanus 2 occidentalis von Linné seu scripsit" handwritten by Linnaeus, and on the verso "herb Alstroemerii / a Linné P."

Although the illustrations from Catesby (1730: t. 56) and Parkinson (1640: 1427) are identifiable as Linnaeus's *Platanus occidentalis*, I prefer to designate the herbarium sheet in the Linnean herbarium Herb. Linn. No. 388.17 (S-LINN) as lectotype of this name because it is the most informative element. This specimen represents the traditional concept and current use of the name *P. occidentalis* (e.g., Kaul, 1997; Nixon & Poole, 2003) and makes a much better lectotype than the illustrations because of its potential to provide types of information (e.g., micromorphological or molecular data) that illustrations cannot (e.g., Jarvis, 2007; Figueiredo & Smith, 2015).

Platanus occidentalis L., Sp. Pl. 2: 999. 1753. TYPE: "Platanus 2 occidentalis," Herb. Linn. No. 388.17 (lectotype, designated here, S-LINN!). Image available at <http://linnaeus.nrm.se/botany/fbo/p/plata/platocc.html.en>.

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Polystichum tiandengense (subg. *Haplopolystichum*; Dryopteridaceae), a New Cave Fern from Guangxi, China

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ABSTRACT. A new fern species, *Polystichum tiandengense* H. He & Li Bing Zhang (Dryopteridaceae), is described and illustrated from a limestone cave in the Guangxi Zhuangzu Autonomous Region, South China. *Polystichum tiandengense* is most similar to *P. cavernicola* Li Bing Zhang & H. He in having oblong to square pinnae with undulate margins, but the new species is distinguished by its pinnae mostly adjacent to each other or imbricating, and mostly sterile (vs. distant from each other and mostly fertile in *P. cavernicola*). *Polystichum tiandengense* is considered to be Critically Endangered (CR), based on IUCN Red List criteria.

Key words: Cave flora, Guangxi, IUCN Red List, *Polystichum*, *Polystichum* sect. *Haplopolystichum*.

Tiandeng County in central-western Guangxi, China, has become well known among field botanists in recent years, especially those interested in the flowering plant family Gesneriaceae and limestone flora. Two species of Gesneriaceae with extremely narrow distributions have been discovered recently from limestone areas of this county (Liu et al., 2010; Tang & Wen, 2011): *Chirita tiandengensis* F. Wen & H. Tang (≡ *Primulina tiandengensis* (F. Wen & H. Tang) F. Wen & K. F. Chung) and *Wentsaiboea tiandengensis* Yan Liu & B. Pan (≡ *Petrocodon tiandengensis* (Yan Liu & B. Pan) A. Weber & Mich. Möller). Here, we add one more species to the limestone flora of Tiandeng County, Guangxi Zhuangzu Autonomous Region, belonging to the fern genus *Polystichum* Roth (Dryopteridaceae).

Polystichum tiandengense H. He & Li Bing Zhang, sp. nov. TYPE: China. Guangxi Zhuang Autonomous Region: Tiandeng Co., Shangying Township, Taoyong Cun, Dongbu Dong (Dongbu Cave), 23°02′34.27″N, 106°57′13.98″E, 550 m, on limestone sedimentary surfaces 15–30 m from the cave mouth, 30 Oct. 2010, *L. Zhang, H. He & Y. Wang 5469* (holotype, CDBI!; isotypes, CTC!, MO!). Figures 1, 2.

Diagnosis. *Polystichum tiandengense* H. He & Li Bing Zhang is most similar to *P. cavernicola* Li Bing Zhang & H. He in having oblong to square pinnae with undulate margins, but is distinguished by having pinnae mostly closely adjacent to each other or imbricately arranged with the lower pinnae sterile (vs. distant from each other and most pinnae fertile in *P. cavernicola*).

Plants perennial, evergreen. Rhizome ascending, to ca. 0.9 cm, 0.5 cm in diam. together with remnant bases of old stipes, scaly at base of stipe (but scales mostly worn out, incomplete, and indistinguishable); roots dull brown when dry, 0.12–0.32 mm in diam., glabrescent or with curved short hairs. Leaves caespitose, 5 to 8 per rhizome, spreading, 4.1–14.2 cm; stipes green, 1.3–3.2 cm, 0.44–0.89 mm in diam. at middle, adaxially canaliculate, scaly; scales spreading or slightly appressed, ovate-lanceolate or deltoid-lanceolate, thinly papery, 1.4–2.2 × 0.45–0.7 mm, brown, apex caudate, base slightly cordate with sides longer than central attached points, margins erose or irregularly lacerate with outgrowths to 0.25 mm. Lamina narrowly lanceolate to narrowly oblanceolate, 1-pinnate, 3.1–8.4 × 1.05–1.82 cm, apex acuminate, ± narrowed toward base from middle of lamina; rachis 0.35–0.61 mm in diam. at middle, apex non-proliferous, green (same color as pinnae) when fresh, turning yellowish green when dry (paler than pinnae), adaxially sulcate, sparsely scaly; scales on lower part of rachis similar to those of stipe, diminishing, with more obviously irregular outgrowths on margin, scales on upper part of rachis deltoid-subulate, to 1.4 × 0.2 mm, base deltate and with irregular outgrowths on margin, subulate apex to 1.2 mm. Pinnae papery, 11 to 16 pairs; petiolules to 1 mm, acroscopically forming angles of ca. 60° with

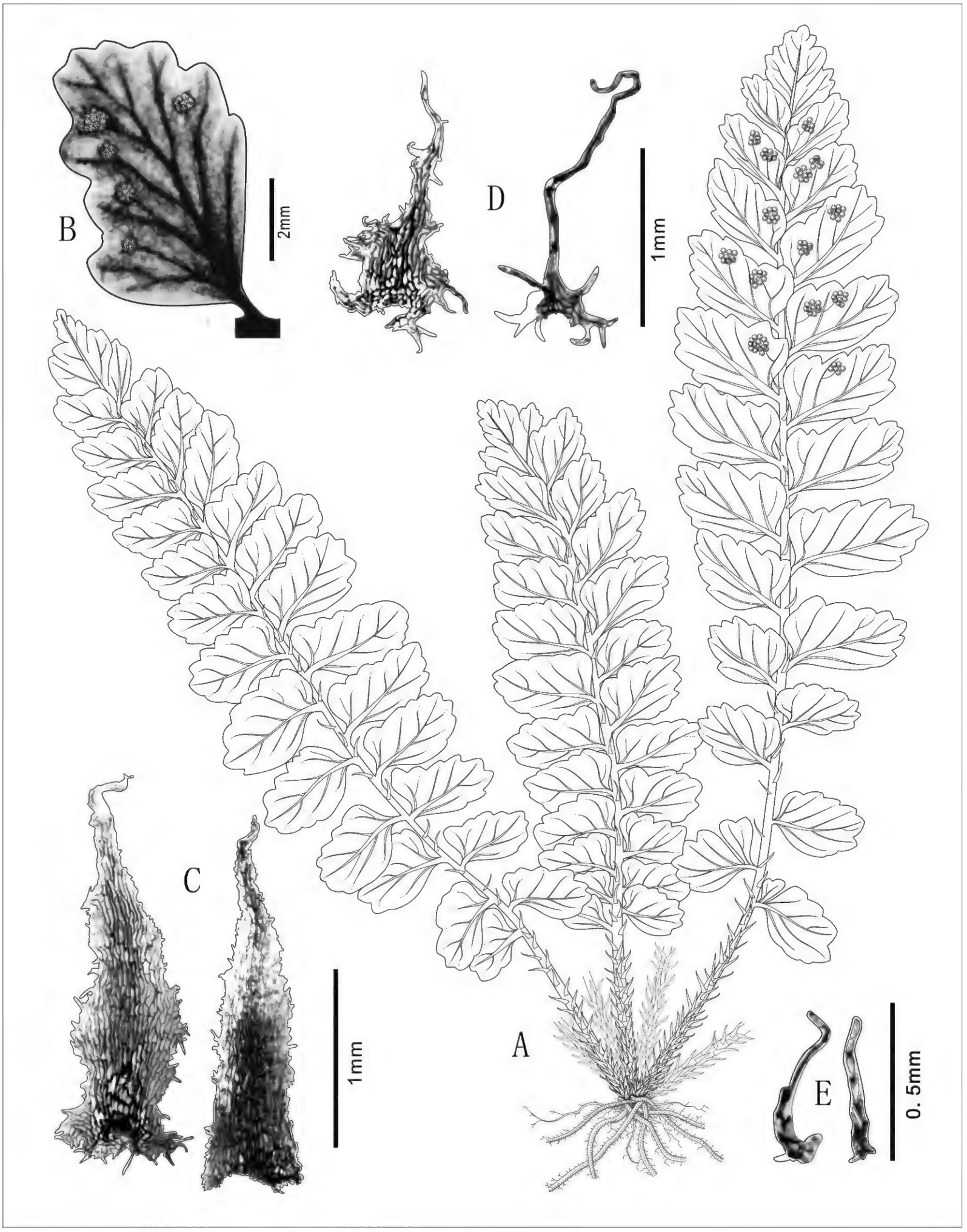

Figure 1. *Polystichum tiandengense* H. He & Li Bing Zhang. —A. Habit. —B. Pinna. —C. Scales from basal portion of stipe. —D. Scales from middle portion of rachis. —E. Microscales from abaxial lamina surface.

rachis, alternate, 1–2 mm apart, close together, or imbricate, asymmetrically rectangular-oblong, or sometimes slightly ovate-oblong, 3.2–9.5 × 2.9–5.1 mm (lowest pairs usually 1/2 as long as longest middle pinnae), basiscopic margins at angles of 60°–85° with rachis; base with basiscopic side widely cuneate or slightly curved distally, acroscopic side truncate and distally with blunt auricle, basal acroscopic side of lowest 1 to 3 pairs of pinnae sometimes deeply incised to near main vein and

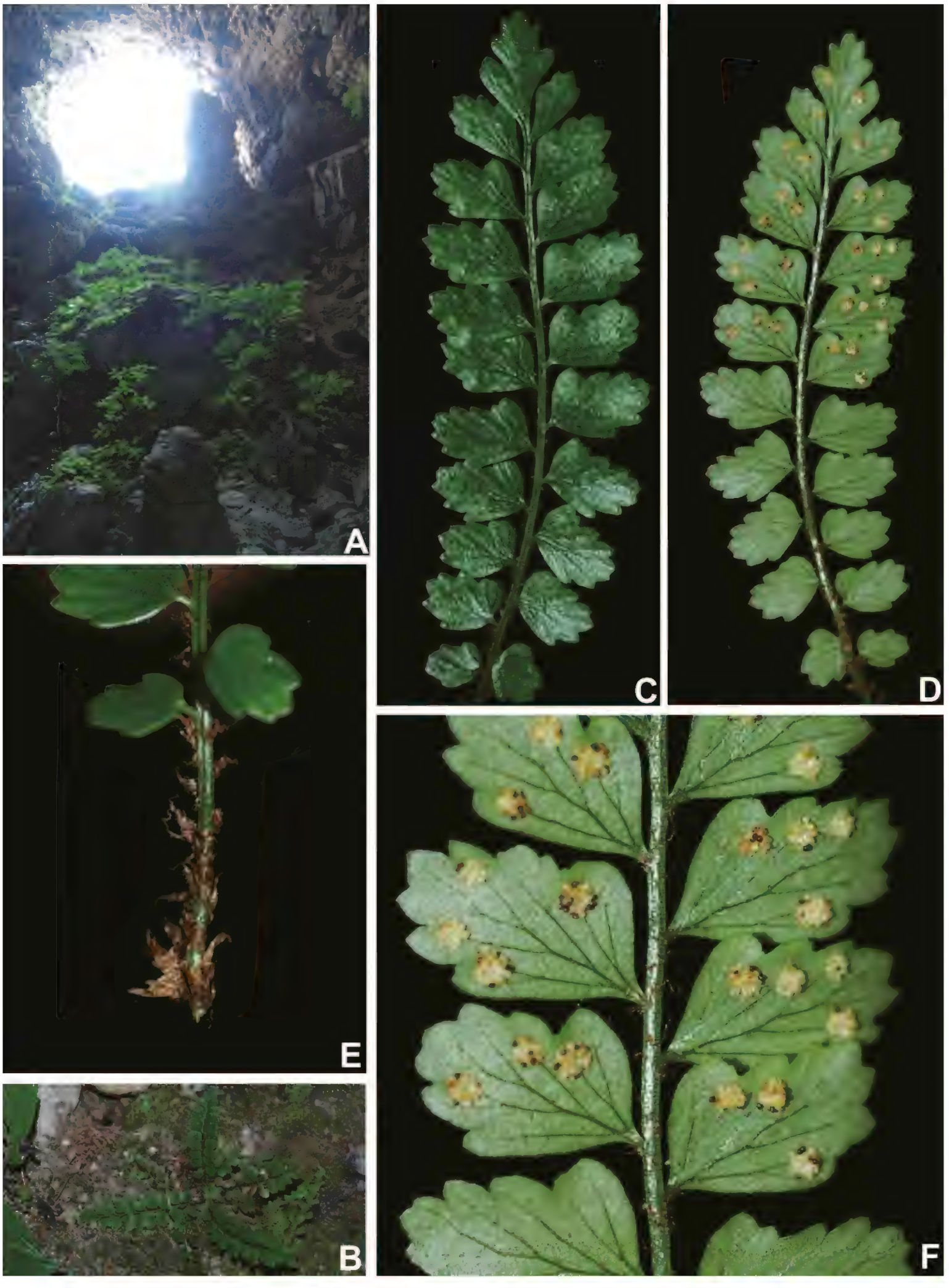

Figure 2. *Polystichum tiandengense* H. He & Li Bing Zhang. —A. Inside view of karst cave in Guangxi where the new species was discovered. —B. Habit in situ. —C. Adaxial view of lamina. —D. Abaxial view of lamina. —E. Lower portion of leaf showing petiole scales. —F. Middle portion of lamina showing sori.

forming obovate lobe to 3 × 2 mm, forming 70°–120° angles at the point where petiolules attach; margins slightly cartilaginous, basiscopic side proximally entire, distally with 1 to 3 undulations or blunt teeth, acroscopic side with 3 to 6 undulations or blunt teeth between tip of basal auricle and pinna apex; apex acute and ending with blunt tooth, all teeth without aristate tip; adaxial surface glabrous, abaxial surface

sparsely covered with microscales; microscales of narrow type, linear-subulate, to 0.48 × 0.06 mm, lightly brown, membranous; venation pinnate, slightly raised abaxially and visible adaxially, lateral veins free, single or once-forked. Lower (3 to)4 to 6 pairs of pinnae sterile; sori terminal on lateral veins, 3 to 6 on acroscopic side, 0 to 2 on distal basiscopic side, ca. 1.2 mm in diam., at middle between margins and main vein (for proximal 1 to 2 sori closer to margins), centers 2–2.5 mm apart from one another; indusia membranous, pale brown, margins irregularly lacerate with 4 to 5 linear outgrowths to 0.75 mm, fugacious. Sporangia round, ca. 0.22 mm in diam., walls ca. 0.13 mm thick, dark brown when mature; annuli with ca. 15 thickened cells; stalks ca. 0.20 mm long; number of spores per sporangium unknown.

Distribution. *Polystichum tiandengense* is known only from Dongbu Dong, Taoyong Cun, Shangying Zhen in the central-western Tiandeng County in south China's Guangxi Zhuangzu Autonomous Region. Although Tiandeng County is in the general karst landscape region, there are few limestone outcrops in the surrounding areas of Dongbu Dong, which makes the cave where this new fern grows quite isolated.

IUCN Red List category. Only one population with ca. 40 individuals of *Polystichum tiandengense* was found. The status of the new species clearly should be classified as Critically Endangered (CR) based on current information and according to IUCN criteria (IUCN, 2014), but more extensive searches are needed to accurately assess the conservation status. Cultivated crops outside the cave mouth and walls built inside the cave were observed, making suitable habitat for this new plant even more limited. This raises serious concerns for conservation.

Etymology. The species epithet is from the Chinese pinyin of the county Tiandeng, where the species is known.

Ecology. *Polystichum tiandengense* grows on the limestone sedimentary surface in twilight conditions inside the cave mouth, ca. 10 m lower than its opening. The altitude outside the cave opening is ca. 550 m.

Some of the plants on the bottom of the cave mouth associated with *Polystichum tiandengense* included seed plants *Carex brunnea* Thunb. (Cyperaceae), *Lysionotus oblongifolius* W. T. Wang (Gesneriaceae), *Setaria plicata* (Lam.) T. Cooke (Poaceae), and three to five unidentified species of *Elatostema* J. R. Forst. & G. Forst. and a species of *Pilea* Lindl. (Urticaceae); fern species *Ctenitis subglandulosa* (Hance) Ching, *Nephrolepis cordifolia* (L.) C. Presl, *Pteris decrescens* Christ, *P. deltodon* Baker, and *P. gallinopes* Ching; two species of *Selaginella* P. Beauv., *S. heterostachys* Baker and *S. ornata* (Hook. & Grav.) Spring, etc.

Taxonomic notes. *Polystichum tiandengense* is one of a number of new species of the genus discovered in recent years, mainly from limestone areas, especially karst caves, in southern China and northern Vietnam (Zhang & He, 2009a, 2009b, 2010, 2011, 2012; He & Zhang, 2010, 2011, 2012; Zhang et al., 2010; He et al., 2012; Luo & Zhang, 2012; Zhang & Wang, 2012; Lu et al., 2014; Han et al., 2016). All of these new cave ferns belong to *Polystichum* subg. *Haplopolystichum* (Tagawa) Li Bing Zhang sect. *Haplopolystichum* Tagawa (Zhang & Barrington, 2013), which has been confirmed as monophyletic (Le Péchon et al., 2016a, 2016b). Morphologically, *P. tiandengense* is most similar to *P. cavernicola* in having oblong to square pinnae with undulate margins, but the pinnae of the former are closely adjacent to each other or even imbricating and only the upper portion of a lamina is fertile, while the pinnae of the latter are distant from each other and most pinnae of a lamina are fertile.

Preliminary molecular study shows that *Polystichum tiandengense* and *P. obliquum* (D. Don) T. Moore have identical plastid *trnL-F* sequences and together form a well-supported clade (Zhang et al., unpubl. data). These two species can be easily distinguished from each other: *P. tiandengense* has blunt undulations on the pinna margin and rounded pinna apices, and most pinnae of a lamina are sterile (Fig. 1), while *P. obliquum* has sharp teeth on the pinna margin and acute pinna apices, and most pinnae of a lamina are fertile (Kung et al., 2001; Zhang & Barrington, 2013).

These three species can be distinguished from one another with the following key:

KEY TO *POLYSTICHUM CAVERNICOLA*, *P. OBLIQUUM*, AND *P. TIANDENGENSE*

1a. Pinna margins often with sharp teeth; pinna apices acute ..... *P. obliquum* (D. Don) T. Moore
1b. Pinna margins undulate, without sharp teeth; pinna apices rounded.
  2a. Pinnae distant from each other and most pinnae of lamina fertile..... ..... *P. cavernicola* Li Bing Zhang & H. He
  2b. Pinnae closely adjacent to each other or even imbricating; only upper portion of lamina fertile .... *P. tiandengense* H. He & Li Bing Zhang

Paratype. CHINA. **Guangxi Zhuang Autonomous Region:** Tiandeng Co., Shangying Township, Taoyong Cun, Dongbu Dong, 550 m, 30 Oct. 2010, *L. Zhang, H. He & Y. Wang 5467* (CDBI, MO).

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Potentilla tuberculifera, a New Species of Rosaceae from Hubei, China

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Abstract. The new species *Potentilla tuberculifera* J. Z. Dong (Rosaceae) is described and illustrated from Guangshui, China. It differs from *P. freyniana* Bornm. in being an indeciduous herb with winter leaves 1.5 × 1.3 cm with a deeply red abaxial surface, and summer leaves green and 4–6.5 × 6–8.5 cm; in having long, red, procumbent stolons, bearing a short branch at each node whose terminal expands into a tubercle with adventitious roots; and in reproducing mostly asexually by tubercles, with matured achenes zero to three per fruit. This new species is considered to be endangered because of its narrow range and limited ability to reproduce.

Key words: China, Hubei, IUCN Red List, *Potentilla*, Rosaceae.

Potentilla L. (Rosaceae) is a complex genus, with ca. 500 widely distributed species (Li et al., 2003). Most species occur in temperate, arctic, and alpine zones of the Northern Hemisphere, with a few in the Southern Hemisphere; 88 species occur in China, with 24 endemic (Li et al., 2003). A broad circumscription of *Potentilla* would include more than 500 species, since *Fragaria* L. has been shown to be nested in *Potentilla* and the inclusion of *Fragaria* in *Potentilla* has been advised by Mabberley (2002). Alternatively, splitting *Potentilla* into several genera and including *Duchesnea* Sm. in *Potentilla* was proposed (Eriksson et al., 1998). A recent study has shown that *Sibbaldia* L. falls into five separate clades of Potentilleae, three within Fragariinae and two within *Potentilla* (Eriksson et al., 2015).

From 2010 to 2012, during the authors' field investigation of traditional anticancer herbs in *Potentilla*, *Duchesnea*, and *Fragaria*, an interesting anticancer herb was found in Guangshui, China. This taxon was provisionally identified as *Potentilla* because it is an unarmed perennial herb with 3-foliolate leaves, free carpels borne on a convex claviform torus, a torus dried when ripe, numerous stamens, and aggregate fruits. We conducted an extensive field exploration for the systematic study of *Potentilla*, *Duchesnea*, and *Fragaria* in Chongqing, Hubei, Henan, Shanxi, Gansu, and Qinghai, China. This species was identified as new, distinguished from known Chinese species on the basis of several characters, including long, red stolons; morphologically different summer and winter leaves, the latter smaller and deeply red beneath; each node bearing a short branch whose end develops into a tubercle with adventitious roots; ascending, radical flower stems; and most achenes sterile, meaning that reproduction is mainly asexual. This paper describes and illustrates the new species as *P. tuberculifera* J. Z. Dong.

Potentilla tuberculifera J. Z. Dong, sp. nov. TYPE: China. Hubei: cultivated at Hubei University for Nationalities [collected from Zhuyuan Village of Baolin Township, Guangshui, China], 15 Apr. 2011, *J. Z. Dong s.n.* (holotype, HIB!; isotype, IBSC!). Figure 1.

Haec species inter congeneros sinenses quoad caules floriferos erectos ascendentesve, folia 3-foliolata, epicalycis segmenta lanceolata apice acuminata etiam antheras dorsifixas *Potentillae freynianae* Bornm. simillima, sed ab ea stolonibus longis rubris procumbentibus ad quoque nodo ramunculum in tuberculum desinentem efferentibus, foliis persistentibus, foliolis aestivalibus majoribus utrinque viridibus hiemalibus minoribus abaxialiter rubris, antheris claviformibus atque fructus acheniis 0 ad 3 distinguitur.

Herbs perennial and indeciduous; root tubers reddish brown, 1–5 cm long, 0.5–1.5(–2) cm in diam.; radicals 3 to 8 or more. Leaf blade 3-foliolate, dentate at margin; petiole diffusely hairy; stipules 2, adnate to base of petiole. In summer, leaves green; radical leaves 1 to 3, 3-foliolate, leaflets 4–6.5 × 6–8.5 cm; petioles 7–21 cm, densely abaxially villous; stolons radical, 1 to 4, slender, red, abaxially villous, 1–1.5(–2.5) m long, 1.5–2 mm in diam., procumbent; each node of stolons bearing a slender short branch and a 3-foliolate leaf with a pair of lanceolate stipules

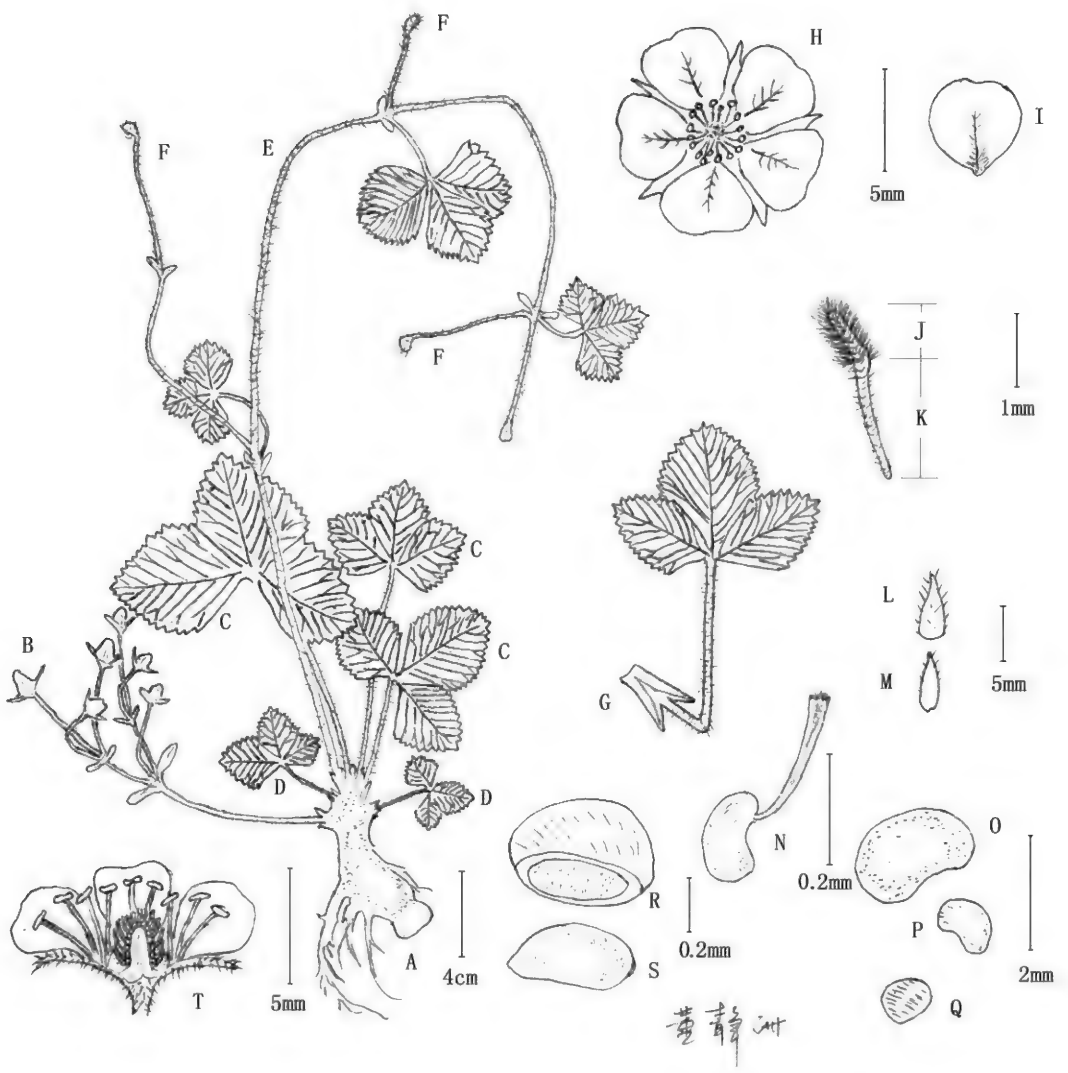

Figure 1. Drawing of the holotype of *Potentilla tuberculifera* J. Z. Dong, *J. Z. Dong s.n.* (HIB). —A. Root tuber. —B. Cyme. —C. Summer leaves. —D. Winter leaves. —E. Stolons. —F. Short branches. —G. Stipule. —H. Flower. —I. Petal. —J. Torus. —K. Pedicel. —L. Calyx. —M. Epicalyx. —N. Pistil. —O. Developing achene. —P. Premature achene. —Q. Mature achene. —R. Achene cut to show thickness of pericarp. —S. Seed. —T. Flower structure. Drawn by Jingzhou Dong.

(0.8–1.0 × 0.3–0.5 cm); petiole 3.5–7.5 cm; leaflets rhombic-oblong, 1.8–4 × 2–5 cm, margin dentate; short branches 2.5–11.5 cm long, 0.6–1.3 mm in diam., densely villous, the end of each short branch expanding into a pink tubercle and developing into a new plantlet with adventitious roots; radical flower stems 1 to 4, ascending or erect, a 3-foliolate leaf or 1-foliolate leaf at each node; stipules lanceolate, apex rarely bifid. Inflorescence a cyme; flowers 0.5–1 cm in diam.; sepals green, ovoid, apex acuminate, 2–3 × 4.5–5.5 mm, margins entire, ciliate; epicalyx lobes lanceolate, rarely bifid, apex acuminate, 2.4–5 × 0.6–1.2 mm, margins entire, ciliate; calyx and epicalyx adnate to form a cupule around a torus, adaxial side of the cupule red, bottom of the cupule densely villous; petals 5, yellow, inserted above the hypanthium, broadly obovate, apex emarginate or rounded, 4–4.5 × 4.5–5.5 mm; stamens usually 20, filaments inserted on the petals; anthers dorsifixed, claviform, 0.4–0.5 × 1–1.3 mm; carpels numerous, free, inserted on a convex receptacle; a receptacle short, club-shaped, 0.3–0.5 × 1–1.3 mm, very densely villous, ripening green and dried when ripe; style subterminal, 1–1.2 mm, deciduous, clavate and tapered toward base, terminal diam. 0.1–0.15 mm, basal diam. 0.04–0.06 mm; ovary oval-shaped, 0.3 × 0.4 mm, single-seeded. Fruits aggregate, brown when ripe, achenes green and reniform and smooth when fresh, ovoid and minute (1.1–1.5 mm in diam.) and brown and rugose when ripe, mostly sterile (0 to 3 achenes fully matured per fruit). In winter, summer leaves and stolons and short branches all dried; a tubercle (at the end of each stolon and short branch) developing into a new plantlet with adventitious roots; radical leaves 2 to 5, 3-foliolate; petioles 1–5 cm, leaflets petiolulate, ovate, 1.5 × 1.3 cm, margin dentate, adaxial surface of winter leaves deeply green and abaxial surface deeply red, the main veins of adaxial surface deeply red; winter leaves withered in summer.

Phenology. *Potentilla tuberculifera* has been observed flowering in March to April and fruiting in April; the summer leaves grow from March to November, and the winter leaves grow from December to April.

Habitat and distribution. *Potentilla tuberculifera* is known from Zhuyuan Village of Baolin Township, Guangshui, China, 113°53′39″E, 31°41′34″N, 118 m. It is found mostly in wet places such as the foot of hillsides, road and field edges, and river banks, mainly with *Duchesnea indica* (Andrews) Teschem. and *D. brunnea* J. Z. Dong (Lei et al., 2011).

IUCN Red List category. According to IUCN conservation criteria (IUCN, 2012), the conservation status of *Potentilla tuberculifera* is evaluated as Endangered, EN A3,4; B2ab(i,ii,iii)c(i,ii,); E. The known range is very small, and there are very few mature seeds per fruit, leading to low sexual reproduction. Aggregate fruits are very small and lack bright color, reducing the likelihood of animal dispersal. Developing new plants from tubercles at the end of short branches and stolons is almost the only effective means of reproduction. In our cultivation test, almost each terminal of the short branches and stolons can grow a tubercle and develop into a new plantlet, which indicates a potentially high asexual reproduction rate. However, in the wild environment, it is very difficult for the terminal tubercles to reach the soil because of blocking effects by grasses and shrubs, which makes asexual reproduction in fact very low (< 20% according to our investigation). Distribution of *P. tuberculifera* may be greatly restricted by these factors. According to our investigation, *P. tuberculifera* was distributed within very limited and fragmented areas. The main endangering factors in the future will include the low reproduction rate and increasing collection of this species for traditional medicinal (anticancer) use.

Etymology. The specific epithet of *Potentilla tuberculifera* refers to the tubercles by which the plant reproduces asexually.

Common name. The proposed Chinese name of *Potentilla tuberculifera* is 红叶委陵菜, *hong ye wei ling cai* (redleaf cinquefoil).

Discussion. The main diagnostic features of *Potentilla tuberculifera* are its root tuber thick, radicels several to many; herbs perennial and indeciduous; summer leaves large and winter leaves small, abaxial surface of winter leaves deeply red; stolons long, procumbent, and red, each node bearing a small short branch; terminal of each short branch and stolon expanding into a tubercle that develops into a new plantlet with adventitious roots on contacting soil; and mainly asexual with nearly no sexual reproduction. These characters are different from those of all species of *Potentilla* recorded in the *Flora of China* (Li et al., 2003) and provide adequate support for the recognition of *P. tuberculifera* as a new species. It is most similar to *P. freyniana* Bornm. in that both have ascending flower stems, leaves 3-foliolate and dentate at margin, petioles and stems abaxially hairy, flowers 0.5–1 cm in diameter, epicalyx lobes lanceolate with an acuminate apex, and anthers dorsifixed. *Potentilla tuberculifera* differs from *P. freyniana* and *P. freyniana* var. *sinica* Migo in being indeciduous with two types of leaves (summer leaves, 4–6.5 × 6–8.5 cm; winter leaves, 1.5 × 1.3 cm), the winter leaves deeply red beneath and having several long creeping stolons with a short branch at each node, claviform anthers, usually sterile achenes, and asexual reproduction via tubercles borne at the terminals of short branches and stolons. *Potentilla*, *Fragaria*, and *Duchesnea* are closely related genera (Kalkman, 1968). The most unusual characters of *P. tuberculifera* are largely sterile achenes and stolons that can produce ramets more easily compared with those of species in the genera *Fragaria* and *Duchesnea*. In *Potentilla*, other known stoloniferous species such as *P. simulatrix* Th. Wolf, *P. reptans* L., *P. anserina* L., *P. gombalana* Hand.-Mazz., *P. smithiana* Hand.-Mazz., and *P. rosulifera* H. Lév. have stolons with adventitious roots but no short branches at nodes.

Potentilla tuberculifera is an endangered species because of its limited spreading ability. Because sexual proliferation is almost impossible, *P. tuberculifera* has evolved asexual reproduction by growing many short branches that spread their terminals to soils and expand into tubercles. These tubercles are potential offspring. Theoretically, a *P. tuberculifera* plant can produce no less than 30 ramets by such asexual proliferation, which was corroborated in our cultivation test. However, in the wild environment, we found that such asexual reproduction is generally restricted. This restriction comes from ambient grasses and shrubs that prop *P. tuberculifera* stolons and short branches up away from the soil, which consequently makes growth of tubercles difficult. Thus, endangerment of *P. tuberculifera* mainly comes from nearly no sexual reproduction and low asexual proliferation.

The characters differentiating the newly described *Potentilla tuberculifera* from species believed to be closely related are summarized in Table 1, and the key to *Potentilla* of Rosaceae from Li et al. (2003) can be amended (under 4b) accordingly as follows.

Table 1. The main diagnostic characters of *Potentilla tuberculifera* J. Z. Dong, *P. freyniana* Bornm., and *P. freyniana* var. *sinica* Migo.

Items	*P. tuberculifera*	*P. freyniana*	*P. freyniana* var. *sinica*
Plant	indeciduous, indument of stems and petioles diffusely villous	deciduous, indument of stems and petioles diffusely villous	deciduous, indument of stems and petioles densely, diffusely villous
Stolons	100–150(–250) cm, red, procumbent, each node bearing a short branch	10–20(–30) cm, green, ascending, no short branches at nodes	10–20(–30) cm, green, ascending, no short branches at nodes
Leaves	summer leaves green; winter leaves much smaller, abaxial surface deeply red	leaves green; no winter leaves present	leaves green; no winter leaves present
Stipules of cauline leaves	broadly lanceolate, rarely bifid	broadly ovate, acutely 4- to 6-incised serrate at apex	ovate, margin entire, rarely bifid
Anther	dorsifixed, claviform	dorsifixed, ellipsoid	dorsifixed, ellipsoid
Mature achenes	0 to 3(to 5), mostly absent	15 to 20(to 30)	15 to 20(to 30)
Reproduction	mainly asexual by tubercles	mainly sexual	mainly sexual

Key to *Potentilla tuberculifera* and Its Closest Relatives in China

1a. Flowering stems erect or ascending.
  2a. Leaves pinnate with 2 or 3(or 4) pairs of leaflets ..... 82. *P. fragarioides* L.
  2b. Leaves 3-foliolate.
    3a. Plants stellate-hairy throughout ..... 81. *P. acaulis* L.
    3b. Plants pilose or glabrescent throughout, not stellate-hairy.
      4a. Leaflets abaxially pilose or glabrescent; flowers 1.2 cm in diam.; epicalyx segments oblong, apex rounded; anthers basifixed, subglobose or ovoid ..... 80. *P. gelida* C. A. Mey.
      4b. Leaflets abaxially diffusely strigose or densely hairy; flowers 0.5–1 cm in diam., epicalyx segments lanceolate, apex acuminate; anthers dorsifixed, ellipsoid or claviform.
        5a. Deciduous; stolons green, short, ascending or inconspicuous, nodes without short branches that produce tubercles; winter leaflets not present; anthers ellipsoid; matured achenes many ..... 83. *P. freyniana* Bornm.
        5b. Indeciduous; stolons red, long, procumbent, each node bearing a short branch that produces a tubercle at its apex; winter leaflets red beneath; anthers claviform; matured achenes 0 to 3 ..... 89. *P. tuberculifera* J. Z. Dong

1b. Flowering stems prostrate or horizontally creeping.

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Primula hubeiensis (Primulaceae), a New Species from Central China

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Abstract. We describe an interesting new *Primula* L. species, *P. hubeiensis* X. W. Li, which is similar to *P. filchnerae* R. Knuth, with leaves pinnately lobed and glandular hairs on the leaves and inflorescences. However, *P. hubeiensis* has more pinnae on the leaves (six to nine vs. three to four pairs) and smaller capsules (3–4 mm diam. vs. 10–16 mm diam.). The persistent calyx of *P. filchnerae* develops into the shape of a lantern when the fruits are mature, but the calyx of *P. hubeiensis* is elongated and split almost to the base during fruiting. *Primula filchnerae* has been placed in *Primula* sect. *Auganthus* (Link) Pax ex Balf. f. due to the character of its indument and deeply lobed leaves; *P. hubeiensis* might also belong in this section, but this needs further confirmation.

Key words: China, *Primula*, Primulaceae.

Primula L. is a large genus in China, with ca. 300 native species (Hu & Kelso, 1996). Hu and Kelso (1996) recognized, including three species in China with leaves pinnately compound or pinnately lobed to the midvein: *P. filchnerae* R. Knuth, *P. cicutariifolia* Pax, and *P. merrilliana* Schltr. Shao et al. (2012) showed that *P. ranunculoides* F. H. Chen is not a synonym of *P. cicutariifolia*, as treated by Hu (1990) and Hu and Kelso (1996), but rather a distinct entity distinguished from *P. cicutariifolia* and *P. merrilliana* by simple kidney-shaped outer leaves and a unique clonal reproductive ability. *Primula filchnerae* was once believed to have been extinct in the wild (Hu, 1990; Hu & Kelso, 1996); however, populations were rediscovered in west Hubei in China in 2006 (Gan & Li, 2015). Based on the ITS region of nuclear ribosomal DNA, Hao et al. (2002) proposed that *P. filchnerae* should be placed in *Primula* sect. *Auganthus* (Link) Pax ex Balf. f. and *P. cicutariifolia* and *P. merrilliana* in *Primula* sect. *Ranunculoides* C. M. Hu.

During our botanical expedition in the mountains in Tongshan County of south Hubei, China, we encountered a population of *Primula* on shady, damp rock crevices whose specimen was morphologically similar to *P. filchnerae* in having pilose, pinnately compound leaves. Yet, the specimen differed from *P. filchnerae* in obvious morphological traits, such as having more pinnae on the leaves and smaller capsules. *Primula filchnerae* was only found in Zhushan County and Zhuxi County of west Hubei (Gan & Li, 2015) and Yang County of southwest Shaanxi, China (Zhang et al., 2015), and the *Primula* population in Tongshan County is at least 500 km distant from those of *P. filchnerae*. We visited it several times and transplanted a few individuals to the Wuhan Botanical Garden, CAS, and observed them carefully. A literature survey (Hu, 1990; Hu & Kelso, 1996; Shao et al., 2012; Gan & Li, 2015) and herbarium research revealed that the species is undescribed. It is therefore described herein as new.

Primula hubeiensis X. W. Li, sp. nov. TYPE: China. Hubei: Tongshan Co., Xiapu Town, Gaoqiaotou Village, Dachengshan, on shady, damp rock crevices, 29°27′5.86″N, 114°27′37.88″E, 623 m, 16 May 2016, *D. C. Bao & H. D. Huang 1368-1* (holotype, HIB!). Figures 1, 2.

Figure 1. Habit and native environment of *Primula hubeiensis* X. W. Li.

Diagnosis. Differs from *Primula filchnerae* R. Knuth in having leaves with 6 to 9) (vs. 3 to 4) pairs of pinnae, calyx tube parted to ca. 3/4 (vs. to ca. 2/5) of its length, corolla tube to 2 times as long as calyx (vs. only slightly longer than calyx), and smaller capsules (3–4 mm diam. vs. 10–16 mm diam.).

Herbs perennial, up to 15 cm high, pilose, glandular. Leaves 13 to 36, all basal in a rosette; petiole much shorter than leaf blade, 1.3–2.8 cm, not dilated at base, covered with glandular hairs; leaf blade oblong to obovate-oblong, 6–15 × 2.5–5 cm, pinnatisect, obtuse at apex, margin coarsely dentate, ciliate; pinnae 6 to 9 pairs, margin coarsely dentate to pinnatifid, the segments ovate to oblong with serrate margins; midvein of leaf blade and pinnae glandular pubescent on both surfaces, abaxial surface otherwise glabrous, adaxial surface glandular-pubescent. Scapes 1 to 2, 3.5–9.6 cm; peduncle 2–6 cm; umbels 1 to 2, 1- to 11-flowered; bracts linear-lanceolate, 4–6 mm; pedicels 1.3–3.8 cm. Flowers distylous; calyx campanulate, 4–6 mm, glandular-pilose outside, glabrous inside, parted to ca. 3/4 of its length, lobes 5, oblong-lanceolate, 1 mm wide, apex acute; corolla purple or pale purple, with white and yellow bands at the base, 1.3–1.8 cm in diam., smaller in pin flowers than in thrum flowers, tube much longer than calyx, 0.9–1.3 cm, lobes 5, broadly obovate, deeply emarginate, 6–7 mm × 5–6 mm; thrum flowers with stamens inserted toward apex of corolla tube, anthers 0.9 mm, filaments absent; pistils 5–6 mm, about half the length of corolla tube; pin flowers with stamens inserted somewhat below the middle of the corolla tube, anthers 0.9 mm, filaments absent; pistils 6.5 mm, about 5/6 the length of corolla tube. Capsule globose, with calyx persistent, 3–4 mm in diam.; seeds numerous, 0.8 mm in diam.

Phenology. *Primula hubeiensis* flowers from February to June, and fruits from May to June.

Distribution and habitat. *Primula hubeiensis* is only known in the wild from its type locality in Tongshan, south Hubei, China. There are ca. 800 individuals clustered on shady damp rock crevices.

Etymology. The specific epithet of *Primula hubeiensis* refers to Hubei Province where the new species was found. The Chinese name is 湖北羽叶报春 (*hubei yuye baochun*).

Discussion. *Primula hubeiensis* resembles *P. filchnerae* in that both species have pinnatisect, glandular-pubescent leaves and umbellate inflorescences. During the fruiting period, the calyx tube of *P. filchnerae* is significantly enlarged and developed into the shape of a lantern (Gan & Li, 2015), whereas the calyx of *P. hubeiensis* is split almost to the base. Three other

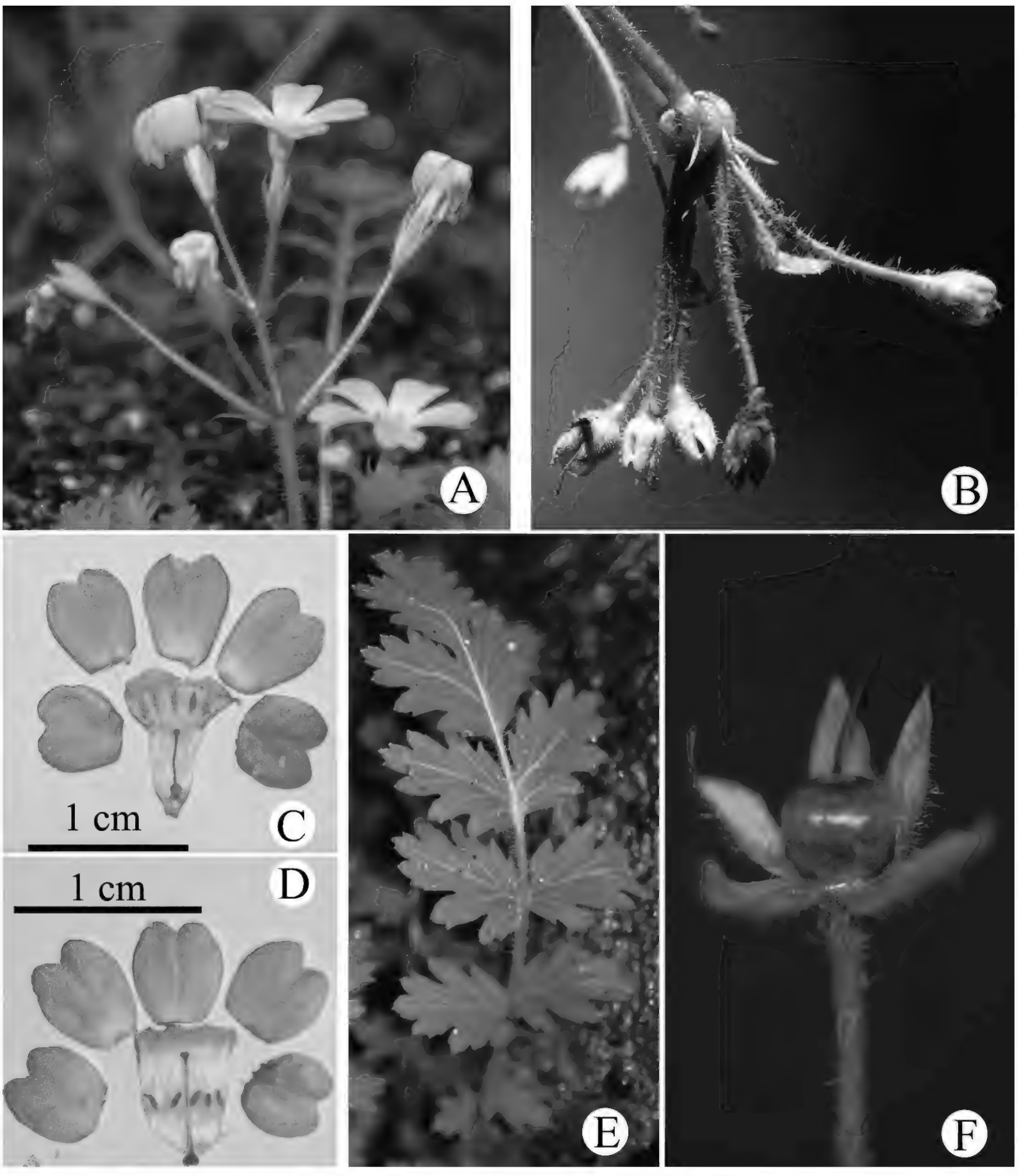

Figure 2. *Primula hubeiensis* X. W. Li. —A. Inflorescence. —B. Infructescence. —C. Thrum flower. —D. Pin flower. —E. Leaf. —F. Fruit.

Chinese species with pinnately divided leaves (*P. cicutariifolia*, *P. merrilliana*, *P. ranunculoides*) are glabrous, so they can be readily distinguished from *P. hubeiensis* and *P. filchnerae*. *Primula filchnerae* has been placed in *Primula* sect. *Auganthus* due to its indument and deeply lobed leaves, while *P. cicutariifolia*, *P. merrilliana*, and *P. ranunculoides* are placed in *Primula* sect. *Ranunculoides* (Hu, 1990; Hao et al., 2002; Shao et al., 2012). Hao et al. (2002) suggested that the character of pinnately lobed or divided leaves had evolved in parallel. Since *P. hubeiensis* is morphologically most similar to *P. filchnerae*, it might also belong in *Primula* sect. *Auganthus*, but confirmation with molecular data would be desirable. Integrating our observation with previous studies (Hu & Kelso, 1996; Shao et al., 2012; Gan & Li, 2015; Zhang et al., 2015), a brief key to the five pinnate-leaved Chinese species follows.

KEY TO PINNATE-LEAVED *PRIMULA* SPECIES IN CHINA

1a. Plant hairy all over 2
1b. Plant glabrous 3
2a. Leaves with 6 to 9 pairs of pinnae; corolla tube to 2 times as long as calyx; capsules 3–4 mm diam ..... *P. hubeiensis* X. W. Li
2b. Leaves with 3 to 4 pairs of pinnae; corolla tube slightly longer than calyx; capsules 10–16 mm diam ..... *P. filchnerae* R. Knuth
3a. Simple outer leaves reniform; scape producing bulblets at apex ..... *P. ranunculoides* F. H. Chen
3b. Simple outer leaves ovate; scape without bulblets 4
4a. Scape with 2 to 3 umbels; apex of corolla lobes rounded ..... *P. merrilliana* Schltr.
4b. Scape with 1 umbel; apex of corolla lobes emarginate ..... *P. cicutariifolia* Pax

Paratypes. CHINA. **Hubei:** Tongshan Co., Xiapu Town, Gaoqiaotou Village, Dachengshan, on the shady damp rock crevices, 19 Feb. 2016, *D. C. Bao & H. D. Huang 1367-1* (HIB), *1367-2* (HIB), *1367-3* (HIB); 16 May 2016, *D. C. Bao & H. D. Huang 1368-2* (HIB), *1368-3* (HIB), *1368-4* (HIB); 13 June 2016, *D. C. Bao & H. D. Huang 1369-1* (HIB), *1369-2* (HIB).

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An Extinct Domesticated Subspecies of Erect Knotweed in Eastern North America: *Polygonum erectum* subsp. *watsoniae* (Polygonaceae)

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Abstract. This paper provides a description of an extinct domesticated subspecies of erect knotweed (*Polygonum erectum* L.). Masses of erect knotweed achenes are often recovered from archaeological sites in eastern North America dating to ca. 3000–600 BP. Several paleoethnobotanical assemblages from the later part of this era (ca. 1000–600 BP) contain achenes that are outside the range of natural variation for erect knotweed. The most well preserved of these archaeological assemblages, a desiccated cache of achenes from the Whitney Bluff site, Arkansas (ca. 900 BP), is compared to four closely related species and subspecies of *Polygonum* L. The Whitney Bluff achenes are most similar to those of *P. erectum*, but differ from modern fruits of this species in three respects: (1) fruits are larger, (2) average pericarp thickness is reduced, and (3) fruit dimorphism is greatly reduced. These differences are typical of domestication syndrome in annual seed crops. The Whitney Bluff assemblage is described as the type specimen of a domesticated subspecies, *P. erectum* subsp. *watsoniae* N. G. Muell.

Key words: Domestication, Eastern Agricultural Complex, fruit morphology, paleoethnobotany, *Polygonum*.

From ca. 3900–600 BP, a suite of native seed crops known as the Eastern Agricultural Complex (EAC) was cultivated in eastern North America (Smith & Yarnell, 2009). Previous studies have documented changes in seed shape and size to demonstrate that two of these crops were domesticated: *Iva annua* L. var. *macrocarpa* (S. F. Blake) R. C. Jacks. and *Chenopodium berlandieri* Moq. subsp. *jonesianum* Bruce Smith (Blake, 1939; Smith & Funk, 1985). The domestication of little barley (*Hordeum pusillum* Nutt.) has also been suggested based on differences in seed morphology between archaeological specimens and modern plants (Hunter, 1992; Adams, 2014). Erect knotweed (*Polygonum erectum* L.) was cultivated alongside these lost domesticates for hundreds of years. It has been found in hearths, storage pits, and human feces at archaeological sites across the Midwest dating from ca. 3000 to 600 BP (Asch & Asch, 1985b; Faulkner, 1991; Powell, 2000; Gremillion, 2004; Simon & Parker, 2006; Mueller, 2017b).

Polygonum erectum and many species within *Polygonum* L. sect. *Polygonum* exhibit seasonal achene dimorphism. Native or naturalized North American species that exhibit seasonal achene dimorphism include: *P. achoreum* S. F. Blake, *P. aviculare* L. complex (sensu Costea & Tardif, 2004), *P. glaucum* Nutt., *P. erectum*, *P. marinense* T. R. Mert. & P. H. Raven, *P. patulum* M. Bieb., *P. plebeium* R. Br., *P. ramosissimum* Michx., and *P. striatulum* B. L. Rob. These species produce two different fruit morphs, referred to by pericarp texture. Tubercled morphs have lower aspect ratios (i.e., a shorter length compared to width) and thicker pericarps with a variety of textures that are diagnostic of different species (Costea et al., 2005). Smooth morphs have a higher aspect ratio (i.e., a longer length compared to width) and thinner pericarps (Fig. 1). Tubercled morphs have layers of cuticle and wax in their pericarps that slow the penetration of moisture and pathogens, allowing seeds to remain viable for several seasons (Yurtseva, 2001). Smooth morphs germinate much more readily the spring after they are produced (Mueller, 2017a). Plants produce tubercled morphs throughout the growing season and begin to produce smooth morphs in mid-September.

Beginning in the 1980s, the achenes found in abundance at archaeological sites were identified by paleoethnobotanists as *Polygonum erectum* on the basis of their surface texture (striate-tubercled) and the distinctive shape of their tubercled achenes (Martin, 1954). Smooth achenes also occurred in most archaeological samples, and were assumed to also come from *P. erectum* plants, although their morphology has not been considered diagnostic to species by botanists or paleoethnobotanists (Asch & Asch, 1985a; Costea et al., 2005).

Speculation about a domesticated subspecies of erect knotweed began in the mid-1980s, when two strange assemblages were reported. At the Late

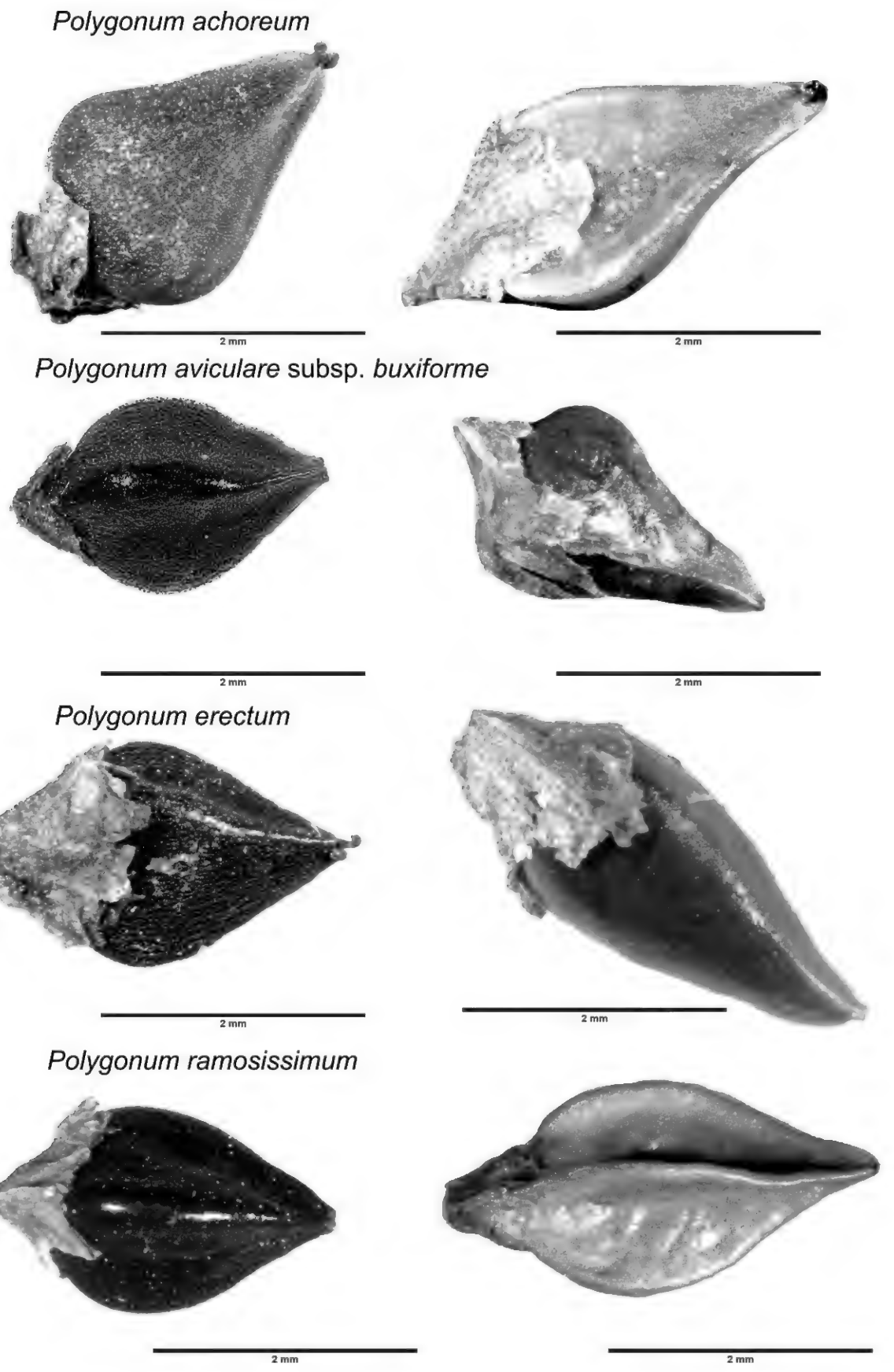

Figure 1. Examples of the dimorphic achenes of the four taxa considered in this analysis. Perianths have been removed. Left: Tubercled morphs with typical surface textures, shape, and size for each species. *Polygonum achoreum* S. F. Blake achenes are usually uniformly tubercled, *P. aviculare* L. subsp. *buxiforme* (Small) Costea & Tardif achenes are coarsely tubercled, *P. erectum* L. achenes are striate-tubercled; compare to those from Whitney Bluff. The *P. ramosissimum* Michx. achene pictured here is roughened, but surface texture varies within this species. Right: Smooth morphs of typical shape and size for each species. *Polygonum erectum* and *P. aviculare* subsp. *buxiforme* achenes pictured here have convex faces, which gives them a plump appearance. This is a rare morphology for *P. aviculare* subsp. *buxiforme* and a very common one for *P. erectum* (see Table 3). *Polygonum ramosissimum* and *P. achoreum* smooth morph achenes have concave faces and a deflated appearance. This *P. achoreum* smooth morph is an example where the central ridge has slumped over so one face is completely obscured, whereas the *P. ramosissimum* smooth morph has a sunken central ridge.

Mississippian (ca. 700 BP) Hill Creek site in Illinois, thousands of carbonized, smooth morph achenes were recovered from a large storage pit—no tubercled morphs were present (Asch & Asch, 1985a). The Hill Creek achenes were also larger than the erect knotweed smooth morphs in available reference collections. To ascertain whether or not erect knotweed was capable of producing such a harvest, Asch and Asch gathered achenes from *Polygonum erectum* populations in Kansas, Missouri, and Illinois

during three different growing seasons (Asch & Asch, 1985a). This survey suggested that erect knotweed does not produce monomorphic harvests: tubercled morphs were always present. Asch and Asch (1985a: 144–145) concluded: "If assessments of variability in wild-type *P. erectum* are accurate, then two alternative explanations can be advanced to account for the peculiarities of the Hill Creek knotweed: (1) They are a domesticated form of erect knotweed. . . or; (2) The Hill Creek achenes are not erect knotweed, but some other species in the knotweed section of *Polygonum*. . .." In particular, Asch and Asch (1985b) suggested *P. ramosissimum*, which was known to produce many smooth, late season achenes (Mertens & Raven, 1965). Fritz (1986) reported a similar near-monomorphic assemblage of large, smooth morph achenes from the Mississippian Whitney Bluff site in Arkansas. These were desiccated in a dry rock shelter and were remarkably well preserved. But without a clearer sense of variability in seasonal achene production within and among species of *Polygonum*, erect knotweed domestication remained an open question.

The Whitney Bluff site was one of 80 Ozarks rock shelters excavated during the 1920s and 1930s by the University of Arkansas Museum. The results of these excavations were never published but are documented in field notes and photographs on file at the University of Arkansas Museum. The well-preserved plant remains from the rock shelters were first examined by Melvin Gilmore and Volney Jones (Gilmore, 1931). Since then, many scholars have examined parts of these important collections (see Fritz, 1986). The crop plant remains from 19 rock shelters, including Whitney Bluff, were analyzed and reported by Gayle Fritz (1986), who also synthesized field and laboratory notes for those 19 sites to reconstruct as much of the archaeological context as possible. The exact location of the Whitney Bluff site is one important piece of information missing from the original field reports, but excavation notes indicate that it is located in Benton County, Arkansas, on the banks of the White River. Materials recovered from Whitney Bluff include a woven bag, baskets, string, mussel shell, stone tools, one potsherd, cane tools, turkey bones, a smashed gourd bowl, and plant foods (Fritz, 1986).

Two large samples of *Polygonum* achenes were recovered from this site (University of Arkansas Museum accession numbers 32-57-3a and 32-57-5c). Both came from a "cache" that also contained a broken gourd bowl and a drawstring bag. It is unknown whether they were two distinct samples each from their own container, or mixed in a single context (Fritz, 1986: 107; 1986: 92). Domesticated *Chenopodium berlandieri* subsp. *jonesianum* was also recovered from this context (Fritz, 1986). A fragment of the gourd from the cache was dated to 785 ± 75 BP (AD 1042–1386; Fritz, 1986). The *Polygonum* itself yielded a date of 885 ± 20 BP (AD 1046–1217; NOSAMS sample number 123466). These two samples are comprised of 1307 achenes. Fritz (1986) measured the length and width of 200 achenes and noted that they were larger than available reference collections of *P. erectum*, and were all smooth morphs.

This study was designed to compare the Hill Creek and Whitney Bluff assemblages (among the 40 other archaeological assemblages that I analyzed in the course of a larger study) to erect knotweed and several other species from which they could possibly be derived. Two possibilities are considered here: (1) all archaeological assemblages, including those from Hill Creek and Whitney Bluff, fall within the range of natural variability for some species native to the study area; or (2) the archaeological assemblages from Hill Creek and Whitney Bluff exhibit domestication syndrome as a result of hundreds of years of cultivation. In either case, the first step is to determine which species is represented at these sites. All but one of the available archaeological assemblages have been distorted by carbonization, and require careful correction before they can be compared to uncarbonized fruits. The Whitney Bluff assemblage, on the other hand, was not subject to distortion because it was preserved via desiccation.

Polygonaceae Systematics and Potential Progenitor Taxa

Species were considered as possible progenitors of the Whitney Bluff assemblage if (1) they had similar fruit and perianth morphology; (2) they were native to pre-Columbian North America; and (3) they occur in the region where ancient knotweed cultivation is documented (parts of modern-day Arkansas, Illinois, Indiana, Iowa, Kentucky, Missouri, Ohio, and Tennessee). The relationships among species of *Polygonum* and between it and related genera have been debated and revised repeatedly for decades, so it was necessary to carefully review the bases for current taxonomies to make sure there were not species in other clades that should be considered, and to double-check the identifications of all specimens sampled for this study.

Polygonum belongs to the family Polygonaceae, a monophyletic group (Cuénoud et al., 2002) characterized by several synapomorphies, including ocrea (sheathing stipules), orthotropous ovules, and quin-

cuncial aestivation. Many members have trigonous achenes, while others have lenticular biconvex or discoid fruits. Older taxonomic treatments recognized three or four distinct subfamilies, but more recently specialists have mainly dealt with two subfamilies separated on the basis of molecular and morphological characters: Eriogonoideae and Polygonoideae (Sanchez & Kron, 2008; Burke & Sanchez, 2011). As currently circumscribed, monophyletic Polygonoideae remain a fairly distinctive clade. Members are herbs, shrubs, or lianas with ocrea, swollen nodes, flowers subtended by bracteoles, lenticular or trigonous achenes, and lobed or entire endosperm (Sanchez et al., 2011).

Within Polygonoideae, three tribes contain species native to eastern North America: Persicarieae (smartweeds), Polygoneae (knotweeds), and Rumiceae (docks). Within Rumiceae, only species in *Rumex* L. are native to the study area (*R. altissimus* Alph. Wood, *R. hastatulus* Baldwin, *R. maritimus* L., *R. salicifolius* Weinm., and *R. verticillatus* L.) Their achenes are trigonous but are easily distinguished from the archaeological specimens by their more acute angles in cross-sectional view, and their symmetrical, ovoid shape in plan-view (i.e., when viewed from above, see illustrations in Martin, 1954: 514). Their tepals, which give the flowers a winged appearance (or in the case of *R. maritimus*, toothed, bristle-like tepals), are very different from the perianths preserved on many desiccated archaeological specimens from Whitney Bluff (see Fig. 2), so a native species of *Rumex* can be positively ruled out.

Several of the smartweeds (*Persicaria* Mill.) that are native to the study area produce biconvex or discoid achenes and can easily be eliminated (*P. amphibia* (L.) Gray, *P. arifolia* (L.) Haraldson, *P. careyi* (Olney) Greene, *P. glabra* (Willd.) M. Gómez, and *P. pensylvanica* (L.) M. Gómez). Three others, *P. bicornis* (Raf.) Nieuwl., *P. hydropiper* (L.) Spach, and *P. lapathifolia* (L.) Delarbre, produce mostly biconvex or discoid achenes and rarely produce trigonous achenes, so archaeological assemblages that are composed entirely of trigonous achenes cannot come from these species. Five other smartweeds native to the study area produce only or primarily trigonous achenes somewhat similar to those found archaeologically (*P. hydropiperoides* (Michx.) Small, *P. punctata* (Elliott) Small, *P. sagittata* (L.) H. Gross, *P. setacea* (Baldwin) Small, *P. virginiana* (L.) Gaertn.). These were also examined but were found to be easily distinguishable from archaeological specimens. The achenes I observed at the Missouri Botanical Garden herbarium conform to the illustrations of Martin (1954) for several of these species (at the time, they were all considered to be members of *Polygonum*). In plan-view, in comparison to the Whitney Bluff achenes, the achenes of these species are variously (1) more symmetrical and ovoid (*P. punctata*); (2) more ovoid, with a sharper point at the apex (*P. hydropiperoides*), or; (3) lack clear faces and are only vaguely trigonous (*P. virginiana*). *Persicaria sagittata* and *P. setacea* have achenes that somewhat resemble the tubercled morphs recovered from archaeological sites in shape, but they have a smooth pericarp texture (the latter species also has much smaller achenes than any recovered archaeologically). Even more obviously (with the exception of *P. virginiana*), the adhering campanulate perianths of these species do not resemble those of the Whitney Bluff specimens (Fig. 2). In addition, within these species of *Persicaria*, the perianth almost always completely encloses the mature achene, whereas the Whitney Bluff achenes are partially exserted.

Polygoneae has recently gone through a major revision based on molecular data. As currently circumscribed, Polygoneae are monophyletic and include *Atraphaxis* L., *Duma* T. M. Schust., *Fallopia* Adans., *Knorringia* (Czukav.) Tzvelev, *Muehlenbeckia* Meisn. (including *Homalocladium* (F. Muell.) L. H. Bailey), *Polygonum* (including *Polygonella* Michx.), and *Reynoutria* Houtt. (Schuster et al., 2011). Besides the members of *Polygonum* in the strict sense sampled for this study (discussed below), there are only two species native to the study area in these genera: *F. cilinodis* (Michx.) Holub, and *F. scandens* (L.) Holub. These can be distinguished from archaeological specimens based on the shape of their achenes (ovoid in plan-view) and, in the case of *F. scandens*, by its distinctive winged tepals.

Within *Polygonum* in the strict sense, Schuster and colleagues (2011) found molecular support for three sections corresponding to the treatment of Ronse De Craene et al. (2004).

1. Species in *Polygonum* sect. *Pseudomollia* Boiss. are mostly restricted to Central Asia and the Middle East, and do not occur in North America at all (Schuster et al., 2011: 1661).
2. *Polygonum* sect. *Duravia* S. Watson is composed of two geographically distinct North American clades, subsection *Duravia* (S. Watson) Ronse Decr. & S. P. Hong of western North America, and subsection *Polygonella* (Michx.) Ronse Decr. & S. P. Hong of southeastern North America. The same close relationship between these two subgroups had previously been recovered using cladistic analyses of morphological characters (Ronse De Craene et al., 2000) and is further supported by the fact that *Polygonum* sect. *Duravia* (including *Polygonella*) does not share the pollen morphology common to all other members of *Polygonum* (Hong et al., 2005), but *Polygonella* is still treated as a distinct genus in the *Flora of North America* (Freeman, 2005). All but one member of subsection *Duravia* occur

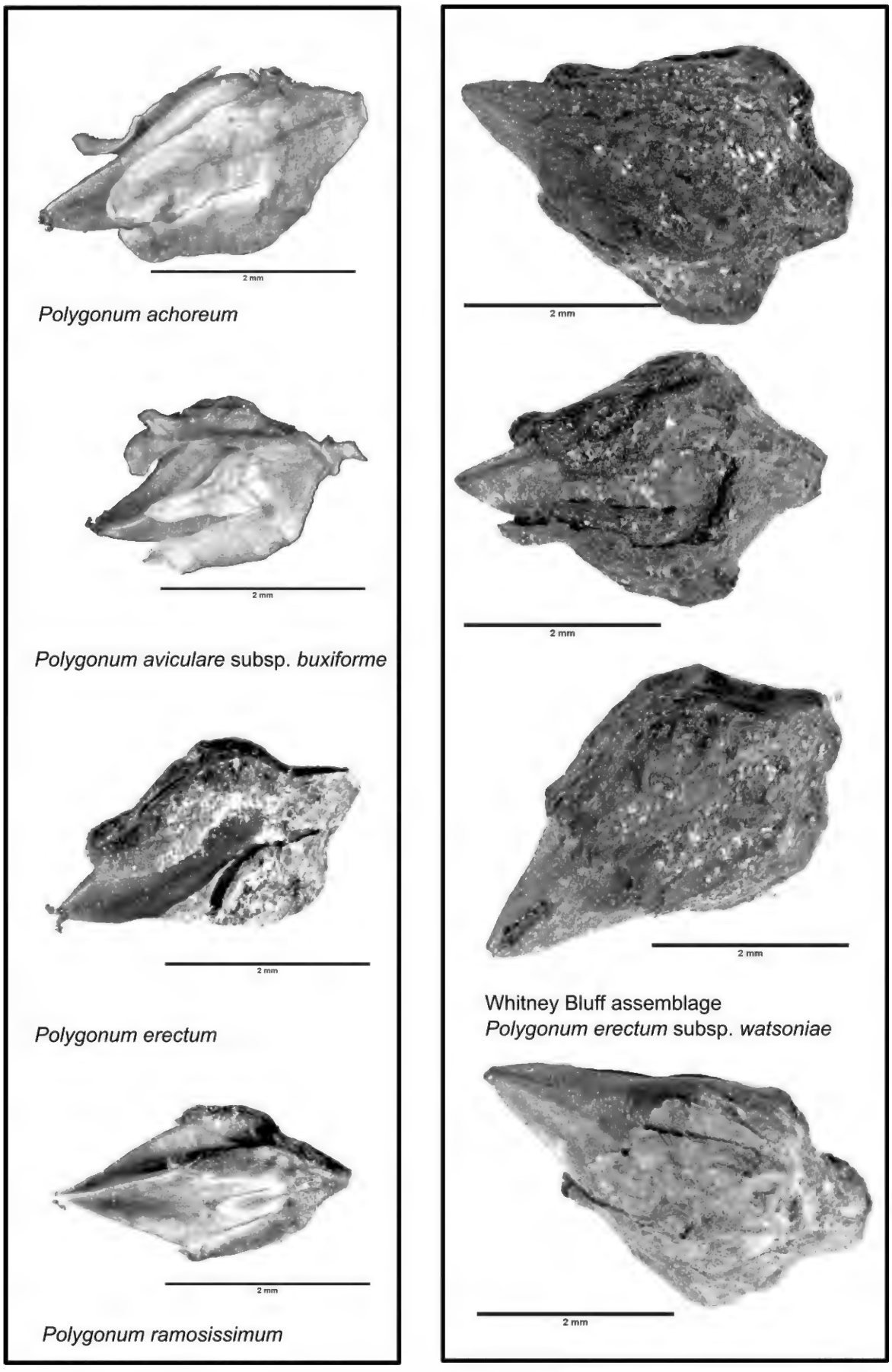

Figure 2. Left: Examples of the smooth morph achenes for each of the four taxa with perianth adhering. *Polygonum ramosissimum* Michx. is significantly more exserted from its perianth than the other three species. Right: Examples of Whitney Bluff achenes, to scale with those from modern species. Convex faces are almost universal within this assemblage, as within *P. erectum* L. (see Fig. 1, Table 3).

only in the western United States. One is very common in the Midwest (*Polygonum tenue* Michx.), but is easily ruled out by its elliptic to oblong fruits. Two species of subsection *Polygonella* occur in the study area (most are restricted to the Gulf Coast states). One of these is a perennial shrub (*Polygonum americanum* (Fisch. & C. A. Mey.) T. M. Schust. & Reveal), and the other is an annual herb (*Polygonum articulatum* L.) that grows on sand dunes and lakeshores. Both have flowers that do not resemble those preserved on archaeological specimens (having distinct rather than connate tepals) and fruits that in cross section have acute angles like those of *Rumex* species.

3. By process of elimination, only species within *Polygonum* sect. *Polygonum* remain for consideration.

Unfortunately, within *Polygonum* sect. *Polygonum* there are some unresolved taxonomic issues at the specific level. This is especially true of the common species *P. aviculare* s. str. and its closely related taxa, which are now treated as the *P. aviculare* complex by

Table 1. Achenes for the photo sample were taken from the loose materials packets of the herbarium specimens listed in Appendix 1. If many fruits were in the packet, a sample of 20 was photographed. Otherwise, all loose fruits were photographed. The measurements and observations reported in Table 3 are drawn from this photo sample.

Herbarium photo sample summary		
Species	# of plants sampled	# of achenes
Polygonum erectum	21	153
P. achoreum	10	60
P. ramosissimum	11	100
P. aviculare subsp. *buxiforme*	10	92
Total	52	405

	# of achenes: total (tubercled /smooth /indeterminate)			
Collection season	*P. erectum*	*P. achoreum*	*P. ramosissimum*	*P. aviculare* subsp. *buxiforme*
June 1–August 31	16 (14/0/2)	23 (21/1/1)	34 (34/0/0)	30 (25/5/0)
September	70 (66/4/0)	24 (24/0/0)	14 (0/14/0)	34 (31/3/0)
October 1–November 24	67 (51/16/0)	13 (6/7/0)	52 (25/27/0)	28 (6/20/2)

the *Flora of North America* (Costea & Tardif, 2004; Costea et al., 2005). Members of this complex are found all over the world as cosmopolitan weeds. The *P. aviculare* complex encompasses numerous taxa that were treated as separate species in overlapping and conflicting taxonomies for centuries (*P. aviculare* L. s. str.; *P. depressum* A. Cunn. ex Meisn. [= *P. arenastrum* Boreau]; *P. neglectum* Besser; and *P. buxiforme* Small). Costea and Tardif (2004) merged what had previously been five species into one because the previously recognized species could not be separated by chromosome number or be reliably differentiated morphologically. They also considered it likely that hybridization is frequent within the *P. aviculare* complex. Of the recognized subspecies, only *P. aviculare* subsp. *buxiforme* (Small) Costea & Tardif is native to North America (Costea & Tardif, 2004).

Specimens of *Polygonum aviculare* subsp. *buxiforme* recently reexamined by Costea et al. (2005) for the *Flora of North America*, or by Yatskievych (2013) for the *Flora of Missouri*, were included in this study. Three other native species within *Polygonum* subsect. *Polygonum* occur in the study area: *P. erectum*, *P. ramosissimum*, and *P. achoreum*. All of the other species of *Polygonum* that occur in the study area are introduced from the Eastern Hemisphere.

Achene Morphology and Dimorphism

There is a long history of attempts to distinguish species of *Polygonum* based on achene morphology (e.g., Martin, 1954; Mertens & Raven, 1965; Wolf & McNeill, 1986). Surface texture, relative width of the three faces, convexity of the faces and edges, and color of tubercled achenes have all been used in taxonomies to distinguish species, yet these treatments frequently contradict one another. For example, while tubercled morph surface texture is sometimes diagnostic of species, it can also vary within species. In *Flora of North America* (Costea et al., 2005), *P. erectum* tubercled morphs are described as "striate-tubercled," i.e., the tubercles are arranged in rows. The specimens I examined confirm this, and most treatments agree. But other species are not so consistent. *Polygonum ramosissimum* tubercled achenes are described in *Flora of North America* as "smooth to roughened, sometimes uniformly or obscurely tubercled." Uniformly tubercled achenes have dense tubercles with no rows discernible, while obscurely tubercled achenes have tubercles that are inconspicuous or restricted to certain areas of the achene. Wolf and McNeill (1986: 478) describe *P. ramosissimum* achenes as "smooth (rarely roughened)," not recognizing any tubercled achenes for this species. Of the 59 *P. ramosissimum* tubercled achenes in my photo sample, all four of these textures are present in addition to seven achenes that are distinctly striate-tubercled, a texture not mentioned by either treatment and considered by paleoethnobotanists to be diagnostic of *P. erectum*. *Polygonum achoreum* achenes are described as uniformly tubercled in most treatments. The majority do fit that description, but 10 out of 51 tubercled achenes in the photo sample are striate-tubercled. *Polygonum aviculare* subsp. *buxiforme* achenes are described in *Flora of North America* as "coarsely striate-tubercled to obscurely tubercled"—about a quarter of those in my photo sample are coarsely striate-tubercled (Costea et al., 2005; Fig. 1). In other words, all four taxa produce the striate-tubercled achenes that most paleoethnobotanists consider diagnostic of *P. erectum*, but at different frequencies (Table 3). Martin

Table 2. Gives the formulas used to generate the morphometric measures reported in Table 3. All image analysis was completed using ImageJ open source image analysis software.

Morphometric measurements		
Measurements	Description	Procedure/Formula
Area	# of pixels within the margins of object	select image of achene, area measured in mm^2
Length	# of pixels along major axis of selected object	draw line to measure length in mm
Width	# of pixels along minor axis of selected object	draw line to measure length in mm
Shape factors		
Aspect ratio	degree of elongation; major axis divided by (mean of) minor axis (axes). Axes derived from an ellipse fitted around the selected object.	[major axis]/[minor axis]
Roundness	roughly inverse of aspect ratio, a measure of elongation of the major axis with respect to the object's area. Axis derived from an ellipse fitted around the selected object.	$4 \times$ ([area]/($\pi \times$ [major axis]
Circularity	relationship between perimeter and area; degree of departure from a circle. 1.0 is a perfect circle, 0.0 is a straight line.	$4\pi \times$ [area]/[perimeter]^2

(1954) recognized that the identification of *Polygonum* seeds to species required consideration of multiple characters including shape, size, and surface characteristics. Even taking into account all of these, Martin (1954: 514) conceded: "the process is not always easy and sure," citing variability within a species and even between the fruits on a single plant.

All of this variability is exhibited by the ostensibly *diagnostic* tubercled achenes—the smooth, late-season achenes have not previously been considered systematically. As noted above, knotweeds exhibit seasonal achene dimorphism: they produce two distinct fruit types in ratios that vary over the course of the growing season. In the past, taxonomists have considered smooth morphs to be undiagnostic. For example, in *Flora of North America* smooth achenes in *Polygonum* sect. *Polygonum* are summarized thus: "Late-season [smooth] achenes in all species are hypertrophied, olivaceous, lanceolate, exserted, and smooth. They have little taxonomic significance" (Costea et al., 2005). Wolf and McNeill (1986) and Mertens and Raven (1965) deal with late-season achenes only to note that they are more common on

Table 3. Formulas for shape descriptors are given in Table 2. Deflation refers to subequal faces that are markedly concave, resulting in a flattened achene, with the central ridge sunken or sometimes slumped over to one side (see Figs. 1 and 2).

Summary statistics by species compared to Whitney Bluff					
	Polygonum achoreum	*P. buxiforme*	*P. erectum*	*P. ramosissimum*	Whitney Bluff
Smooth morphs					
Area	3.38 ± 0.257*	2.28 ± 0.349*	3.22 ± 0.780*	4.21 ± 1.338*	5.66 ± 0.683
Length	3.20 ± 0.222*	2.69 ± 0.270*	3.23 ± 0.329*	3.64 ± 0.609*	4.16 ± 0.243
Width	1.70 ± 0.095*	1.35 ± 0.163*	1.63 ± 0.190*	1.78 ± 0.366*	2.30 ± 0.257
Circularity	0.54 ± 0.137*	0.52 ± 0.154*	0.44 ± 0.126	0.49 ± 0.091	0.46 ± 0.073
Aspect ratio	1.89 ± 0.126	2.00 ± 0.434*	1.95 ± 0.279*	2.03 ± 0.283*	1.76 ± 0.227
Roundness	0.53 ± 0.034	0.52 ± 0.108*	0.52 ± 0.072*	0.50 ± 0.07*	0.58 ± 0.069
Deflated/total	9/9	12/15	41/41	1/20	3/200
Tubercled morphs					
Area	3.34 ± 0.651	2.37 ± 0.354	3.49 ± 0.528	2.99 ± 0.761	4.15
Length	2.85 ± 0.309	2.40 ± 0.197	2.92 ± 0.202	2.79 ± 0.433	3.40
Width	1.88 ± 0.222	1.55 ± 0.171	1.88 ± 0.208	1.63 ± 0.181	2.23
Circularity	0.64 ± 0.199	0.65 ± 0.515	0.56 ± 0.104	0.56 ± 0.086	0.55
Aspect Ratio	1.47 ± 0.125	1.52 ± 0.156	1.51 ± 0.147	1.65 ± 0.192	1.51
Roundness	0.69 ± 0.058	0.66 ± 0.063	0.67 ± 0.065	0.61 ± 0.067	0.66
Striate-tubercled/total	10/51	14/62	131/131	7/59	1/1

* Indicates a significant difference from the Whitney Bluff assemblages according to Tukey's honest significant difference test, $P < 0.05$.

some species than others, and to point out that plants bearing such fruits have been mistaken for separate species in the past. This study by necessity asks whether or not the morphology of smooth achenes is diagnostic of particular species, since the goal here is to identify archaeological assemblages composed mostly, or occasionally exclusively, of smooth achenes.

Materials and Methods

I concur with Fritz's (1986) observation that the two samples of *Polygonum* from Whitney Bluff are very similar and probably came from the same context. They are treated as a single sample in this analysis. The morphometric analysis of achenes was performed using digital images of a photo sample. The Whitney Bluff assemblage is only one of 40 archaeological assemblages that I analyzed as part of a larger study of pre-Columbian agricultural practice. Per sampling protocol for the larger study, the size of the photo sample was determined by the weight of the entire assemblage. I photographed one achene per 0.01 g. I chose to subsample by weight rather than by count in order not to bias the sample against poorly preserved carbonized assemblages, where fewer measurable achenes were present as a percentage of the total identifiable knotweed. Although the Whitney Bluff *Polygonum* was not carbonized, I adhered to this sampling strategy for the sake of consistency. I randomly selected a photosample of 80 achenes from 32-57-3a and 120 from 32-57-5c. Many of the Whitney Bluff achenes retain some or all of their perianth parts. The presence of the perianth or parts of the perianth may somewhat inflate area and width measurements, but the perianths of the Whitney Bluff achenes generally tightly conform to the shape of the underlying fruit (Fig. 2). Of the 1307 achenes in the two samples, all but two were smooth morphs. The two tubercled morphs were also photographed and measured and are described below (Fig. 3). Measurements of length and width reported here are very similar to those reported by Fritz (1986) on two different subsamples of 100 achenes.

A total of 73 herbarium specimens of *Polygonum achoreum*, *P. aviculare* subsp. *buxiforme*, *P. erectum*, and *P. ramosissimum* from the Missouri Botanical Garden and the National Herbarium were examined (Appendix 1). The photo sample used for morphometric analysis was taken from 51 of these (Table 1). These species were sampled because (1) they had fruit and perianth morphology similar enough to that of the Whitney Bluff assemblage to warrant comparison, (2) they were native to pre-Columbian North America and, (3) they occur in the region where ancient knotweed cultivation is documented. I considered *P. erectum* and *P. achoreum* as two different species (Mertens & Raven, 1965; Löve & Löve, 1982; Wolf & McNeill, 1986; Costea et al., 2005; Yatskievych, 2013). I did not consider specimens of *P. aviculare* other than *P. aviculare* subsp. *buxiforme*, although given the messy taxonomic history, many of these specimens may be native plants or hybridized with native plants. Only loose fruits were removed from the herbarium sheet packets on specimens collected since 1950, per the sampling regulations of the Missouri Botanical Garden and the National Herbarium. These loose fruits comprise the photo sample, whose morphology is described in detail below. Because taxonomy within *Polygonum* has varied greatly over the past century, whenever possible I only used samples that had been examined for the latest treatments in the *Flora of North America* and/or the *Flora of Missouri* (Costea et al., 2005; Yatskievych, 2013). Where I had to use specimens that were not examined for these treatments, I double-checked the identification myself using keys from those treatments.

I took grayscale photographs of each fruit selected for the photo sample in the same orientation with the widest of their three sides down (Figs. 1, 2) using a Zeiss SV11 microscope (Zeiss, Oberkochen, Germany) fitted with a manual stage, z-stepping motor, and an AxioCam MRC5 digital camera (Zeiss). I recorded the texture of each pericarp as "Smooth" or "Tubercled." Using ImageJ open source software, I measured several shape factors and area, length, and width. In order to take area and shape measurements, the object to be measured must be thresholded (differentiated from the background on the basis of color or shade). With solid objects such as seeds on a white or black background it is usually easy to select all non-white or non-black pixels, but it is sometimes necessary to manually trace the outline of fruits that are similar in color to the background. The shape factors collected for each achene are aspect ratio, roundness, and circularity. Formulas for each are given in Table 2. Length and width are the two longest perpendicular straight line distances across the image of the achene. All morphometric measurements were taken using ImageJ.

Results and Discussion

The Whitney Bluff assemblage is most obviously different from a normal harvest of erect knotweed achenes in that it is very nearly monomorphic: smooth morph achenes are overwhelmingly predominant. In the recent herbarium specimens examined for this study, the ratio of smooth to tubercled morphs

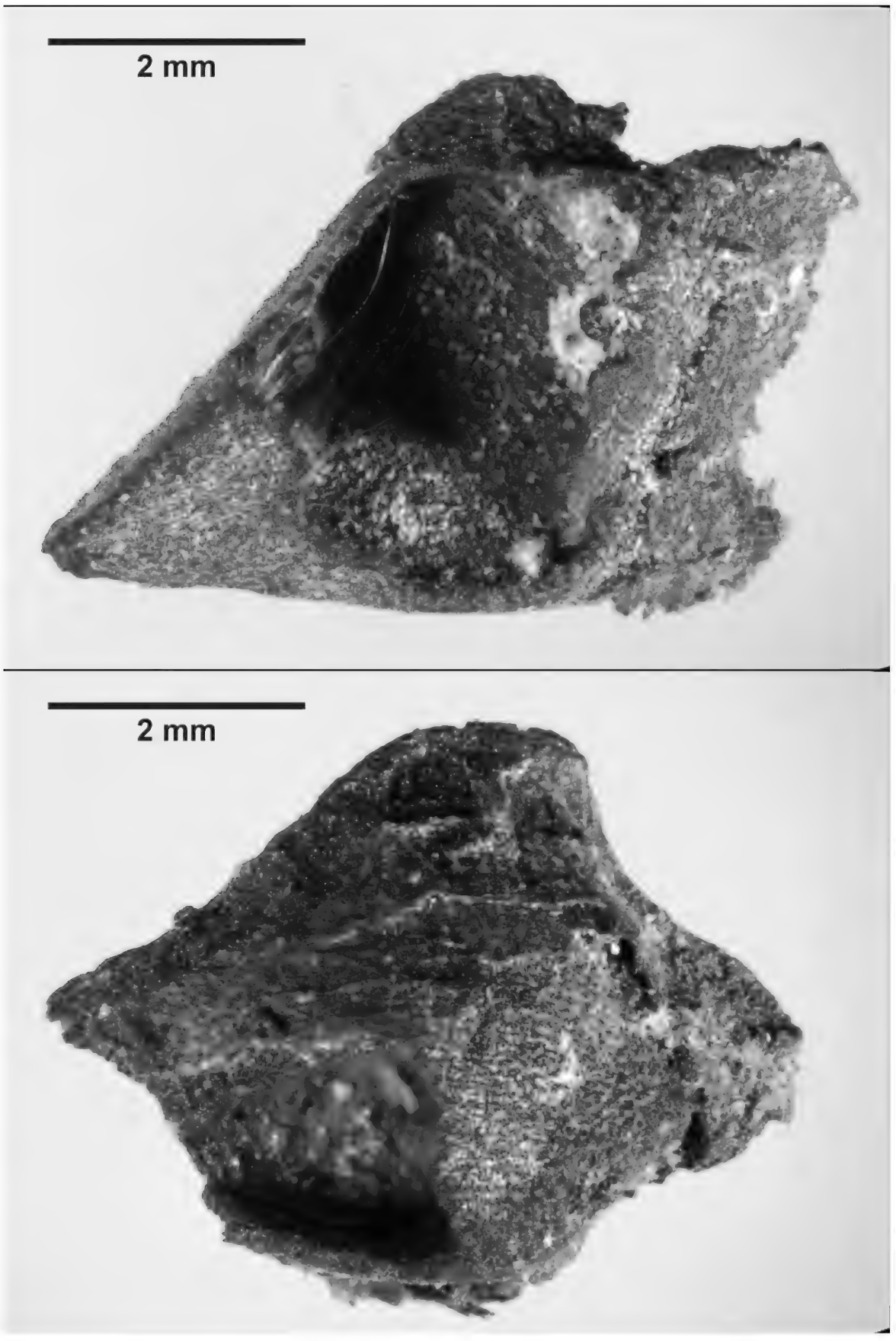

Figure 3. Whitney Bluff tubercled morphs, with striate-tubercled surface texture. Compare to tubercled morphs in Figure 1.

varies from species to species, among individuals of the same species, and according to the season (Table 1). Seasonality is certainly a factor for all four taxa: smooth achenes are rare before the middle of September. But even with only a small photo sample of five to 20 seeds from each plant, there were only two instances of uniformly smooth morph photo samples from any one plant. This indicates that smooth morphs rarely predominate in any of the four taxa: even late in the season, tubercled morphs are present even in a small random sample of fruits. The two exceptions were both *Polygonum ramosissimum* specimens, one collected on September 22 and the other on October 23. After analyzing the photo samples from these plants ($n = 12$ and $n = 14$, respectively), I checked whether the plants in question had really produced only smooth morphs. All of the hundreds of observable achenes on both specimens were smooth morphs. Thus *P. ramosissimum* does occasionally produce monomorphic assemblages of smooth morph achenes. Further study of this species is necessary to determine what conditions produce this effect. However, the Whitney Bluff achenes are easily distinguished from those of *P.*

ramosissimum. Smooth achenes of *P. ramosissimum* are almost completely exserted from their perianth. Indeed, plants with this fruit morphology were once thought to be a different species, *P. exsertum* Small, but are now considered a variant of *P. ramosissimum* (Mertens & Raven, 1965: 85). In contrast, Whitney Bluff smooth achenes are more enclosed in their perianths, similar to those of the other three species examined (Fig. 2).

The Whitney Bluff assemblage resembles *Polygonum erectum*, as opposed to any of the other three species, in having smooth morph achenes with convex rather than plane or concave faces. This criterion refers to the degree of fruit concavity as observed on the two subequal faces of the achene (see Figs. 1, 2). When these faces are markedly concave, the achene becomes flattened, with the central ridge sunken or sometimes slumped over to one side. Mertens and Raven (1965: 85) described the late-season achenes of *P. ramosissimum* as "flattened and wrinkled." This description is apt and also applies to most of the smooth morphs of *P. aviculare* subsp. *buxiforme* and *P. achoreum* observed for this study, but not to those of *P. erectum*. *Polygonum erectum* smooth achenes, like the Whitney Bluff achenes, almost always have convex faces when mature, giving them a plump appearance in comparison to the other species (Fig. 1, Table 3). *Polygonum erectum* is the only species that produces a majority of plump, smooth morphs, although a small minority of smooth *P. aviculare* subsp. *buxiforme* achenes was also relatively convex.

The Whitney Bluff smooth morphs are significantly different from all four modern taxa in terms of size, whether measured by area, length, or width, as expected of a domesticated plant (Table 3). Fruit circularity indicates that the Whitney Bluff assemblage, *Polygonum erectum*, and *P. ramosissimum* form a similar group in terms of shape, and that *P. aviculare* subsp. *buxiforme* and *P. achoreum* are significantly different (Table 3).

Of the 1307 achenes with observable pericarps in the Whitney Bluff assemblage, two were tubercled morphs. Both exhibit the striate-tubercled surface texture and shape typical of *Polygonum erectum* tubercled morphs (Fig. 3, compare with Fig. 1). All four taxa sometimes produce striate-tubercled achenes, but only *P. erectum* produces a majority of this type (Table 3). Only one is complete enough to be measured, and it is compared to the tubercled morphs from the herbarium samples in Table 3. Similar to the smooth morphs, the Whitney Bluff tubercled achene is also uncommonly large and groups by circularity with *P. erectum* and *P. ramosissimum*. The two tubercled achenes from Whitney Bluff are thus most parsimoniously identified as *P. erectum*.

This study suggests that the morphology of smooth morph (late-season) achenes within *Polygonum* sect. *Polygonum*, which has long been considered taxonomically useless, does vary systematically. Both the size and shape of smooth morphs differ among the four taxa considered here (Table 3), suggesting that further studies of smooth achene morphology may be taxonomically fruitful. These results also suggest that paleoethnobotanists should be more cautious when using pericarp surface texture to identify assemblages to species. Tubercled morph surface texture cannot be used to positively determine the species when only a few achenes are preserved (as often occurs with archaeological assemblages) because all four of the taxa examined here occasionally produce striate-tubercled achenes. As with smooth morphs, both area and circularity are useful for distinguishing between species. Mean area can be used to reliably distinguish *P. ramosissimum* and *P. aviculare* subsp. *buxiforme* from the other species, but *P. erectum* and *P. achoreum* have similarly sized tubercled achenes (Table 3). In terms of circularity, for both tubercled and smooth morphs, *P. ramosissimum* and *P. erectum* form one group, and *P. aviculare* subsp. *buxiforme* and *P. achoreum* form another (Table 3). Using a combination of metric and non-metric criteria, small assemblages of tubercled morphs or even single achenes can be more confidently assigned to species. For example, the Whitney Bluff tubercled achene groups with *P. erectum* and *P. ramosissimum* in terms of circularity and its surface texture indicates that it is more likely to belong to the former. Since it is much larger than normal for any of the species, area is not helpful in this case.

The Whitney Bluff achenes are identified as a subspecies of *Polygonum erectum*, rather than one of the other possible species, on the weight of several lines of evidence. Circumstantial evidence strongly supports the hypothesis that the Whitney Bluff achenes came from erect knotweed plants: *P. erectum* was cultivated for ca. 1500 years; it is documented in clear storage, cooking, and consumption contexts at hundreds of sites; and there is no evidence that any other species of knotweed was ever cultivated. But strong evidence is required to argue for an extinct domesticate, and other possible explanations must be ruled out. Of the four taxa of *Polygonum* native to the study area, only *P. ramosissimum* occasionally produces monomorphic harvests of smooth achenes. But the Whitney Bluff achenes are distinguishable from *P. ramosissimum* smooth morphs on the basis of

two clear characters: they are not nearly as exserted from their perianths and they do not have concave faces. The latter character also differentiates the Whitney Bluff achenes from those of *P. achoreum* and *P. aviculare* subsp. *buxiforme*, which in any case are shaped quite differently, being much more circular in plan-view (Table 3). The two tubercled morphs from Whitney Bluff, with their striate-tubercled surface texture, also support the designation of the Whitney Bluff assemblage as a subspecies of *P. erectum*.

This conclusion could be further strengthened by extracting DNA from the Whitney Bluff achenes and comparing it to that of modern species. Ancient DNA (aDNA) could also help answer questions about how the process of domestication unfolded. It is probable that aDNA is preserved in the Whitney Bluff *Polygonum* achenes: two previous projects have successfully extracted DNA from *Chenopodium berlandieri* seeds (Kistler & Shapiro, 2011) and *Cucurbita* L. seeds (Kistler et al., 2015) from nearby rock shelters that are the same age or older than the *Polygonum* cache at Whitney Bluff. Although permission has been granted to attempt aDNA extraction from the Whitney Bluff *Polygonum*, this project is hampered by the fact that information about genetic variation within *Polygonum* is very low-resolution. An initial attempt to use plastid genome variation to characterize the four taxa analyzed here was a failure: plastid genome variability was found to be too low (Logan Kistler, pers. comm.). Assembly of a nuclear genome for *P. erectum* is the next step in this project and is currently underway.

Although the archaeological specimens described here are most similar to *Polygonum erectum*, they differ from modern *P. erectum* in three ways. Average size for the Whitney Bluff achenes is greater than that of any of the four modern taxa, whether measured by area (as determined from photographs), length, or width (Table 3). They are also distinguished by a great reduction in achene dimorphism. Of the 32 *P. erectum* herbarium specimens and hundreds of wild-growing plants I observed during the course of this study, none produced a monomorphic harvest. Even in late October and early November, *P. erectum* plants still usually produce a majority of tubercled morph fruits. Preliminary data indicate that a typical late October/early November harvest of a population of *P. erectum* plants will yield a proportion of smooth morphs between 30% and 70% (Mueller, 2017a). Both the Whitney Bluff assemblage and the Hill Creek assemblage are thus far outside the normal range of variation. Because the plant represented in these assemblages produces fewer tubercled morphs, which have thicker pericarps, than *P. erectum* subsp. *erectum*, average pericarp thickness would be greatly reduced for any given harvest from the former. Both the increase in fruit size and the reduction of germination inhibitors are classic indicators of domestication syndrome in annual seed crops. Considering the extensive contextual evidence for cultivation from archaeological sites, this material should be considered an extinct domesticate. It is therefore recognized herein as a new subspecies of *P. erectum*. The probable selective pressures that caused the evolution of the domesticated subspecies documented in this study have been explored experimentally (Mueller 2017a) and archaeologically (Mueller 2017b, 2017c).

Taxonomic Treatment

Polygonum erectum L. subsp. **watsoniae** N. G. Muell., subsp. nov. TYPE: U.S.A. Arkansas: Benton Co., Whitney Bluff rock shelter (3BE20), 1932, *W. Henbest & C. Finger Jr. 32-57-5c* (holotype, UARK No. 20121!; isotype, Arkansas Museum!).

Diagnosis. *Polygonum erectum* L. subsp. *watsoniae* N. G. Muell. most closely resembles *P. erectum* subsp. *erectum*, but can be distinguished from it by greatly reduced achene dimorphism: almost all achenes have smooth pericarps, 30–70 μ thick, with very few achenes having striate-tubercled pericarps 120–150 μ thick; smooth achenes are larger than those of *P. erectum* subsp. *erectum*, averaging 4.2 × 2.3 mm, and are shaped differently, having a lower aspect ratio (mean 1.76); they also differ from smooth achenes of *P. ramosissimum* Michx. in having a plump appearance caused by convex subequal faces, unwrinkled pericarps, and retained perianths that cover > 50% of the length of the achene.

Discussion. Assemblages of *Polygonum erectum* subsp. *watsoniae* have been found in excavations of Native American sites in Arkansas and Illinois dating to ca. AD 1000–1400, along with the seeds and fruits of other plants cultivated by the ancestors of Native Americans. This domesticated subspecies is now believed to be extinct. Its name commemorates archaeologist Patty Jo Watson, whose pioneering research was instrumental to the recognition of the Eastern Agricultural Complex.

The holotype preserved at UARK is a subsample taken from one of the two large samples of Whitney Bluff achenes that are preserved at the Arkansas Museum; the remainder of that sample constitutes an isotype.

Paratype. U.S.A. **Arkansas:** Benton Co., Whitney Bluff rock shelter (3BE20), 1932, *W. Henbest & C. Finger Jr. 32-57-3a* (Arkansas Museum).

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Appendix 1. Herbarium specimens examined for this study.

HS ID	Herbarium	Number	Determined by	State	Collection month	Photo sample
Polygonum achoreum S. F. Blake						
11	US	1826799	Costea	MN	June	2
51	MO	2224128	Katz	NE	June	2
10	US	2876171	Costea	MT	July	5
50	MO	3667043	Rhode	ND	July	5
8	US	2329091	Costea	QC	Aug.	4
9	US	1826754	Costea	SD	Aug.	5
7	US	2004170	Costea	ND	Sep.	5
49	MO	4957772	Cusick	OH	Sep.	9
53	MO	5839142	Yurtseva	MO	Sep.	10
52	MO	5288218	Yurtseva	MO	Oct.	13
Subtotal						60
Polygonum aviculare L. subsp. *buxiforme* (Small) Costea & Tardif						
1	US	1465810	Costea	KY	June	3
2	US	1465809	Costea	KY	June	1
6	US	1436192	Costea	AK	June	5
4	US	2235643	Costea	IA	July	3
55	MO	2588081	Hinds	IL	July	
3	US	1113306	Costea	ME	Aug.	5
58	MO	4074038	Brant	MO	Aug.	13
5	US	1925995	Costea	RI	Sep.	5
54	MO	4641381	Brant	MO	Sep.	
56	MO	3671302	Hinds	AL	Sep.	8
57	MO	4005057	Hinds	TX	Sep.	20
70	MO	2158865	Brant	MO	Oct.	22
72	MO	5093323	Hudson	MO	Oct.	
71	MO	5093336	Hudson	MO	Oct.	7
Subtotal						92
Polygonum erectum L.						
16	US	2727807	F. R. Fosberg	VA	June	5
38	MO	5393684	Reed	KY	June	
39	MO	5393682	Reed	KY	June	
48	MO	5400840	Moe	IL	June	
17	US	2667449	Costea	OH	Aug.	2
34	MO	4292384	Brant	MO	Aug.	3
42	MO	3450151	Thomas	TN	Aug.	6
44	MO	4292383	Brant	MO	Aug.	
12	US	1925748	Costea	PA	Sep.	5
13	US	298208	Costea	PA	Sep.	4
15	US	3495558	L. B. Smith	PA	Sep.	3
18	US	228405	Costea	IN	Sep.	3
20	US	309488	Costea	IN	Sep.	4
21	US	797318	Costea	WV	Sep.	3
29	US	2746624	Kral	AL	Sep.	
30	US	2605290	Costea	NY	Sep.	

Appendix 1. Continued.

HS ID	Herbarium	Number	Determined by	State	Collection month	Photo sample
33	MO	4292359	Brant	MO	Sep.	
35	MO	5814504	Smith	PA	Sep.	11
36	MO	4074041	Brant	IL	Sep.	5
37	MO	6152618	Reid and Gentry	AR	Sep.	5
40	MO	5393680	Pretz	PA	Sep.	10
41	MO	3680707	Hill	MD	Sep.	
43	MO	3476886	Raven	MO	Sep.	
45	MO	3913996	Christ	MO	Sep.	
46	MO	3226768	Brant	MO	Sep.	17
47	MO	3493891	Brant	MO	Sep.	
65	MO	5151138	Brant	MO	Sep.	
14	US	298794	Costea	PA	Oct.	5
19	US	2664048	Costea	KY	Oct.	4
31	MO	1135807	Brant	MO	Oct.	10
32	MO	2158858	Brant	MO	Oct.	10
69	MO	5159294	Mueller	MO	Oct.	18
22	Washu Pbot	65	Blake	MO	Oct.	20
Subtotal						153
Polygonum ramosissimum Michaux						
23	US	2067911	Webster and Wilbur	TX	June	4
60	MO	5970916	Brant	MO	June	10
59	MO	4236452	Brant	MO	Aug.	10
64	MO	2005129	Katz	ND	Aug.	10
24	US	1125	Costea	TX	Sep.	
25	US	1888718	Costea	KY	Sep.	
73	MO	4J657068	Summers	MO	Sep.	14
28	US	2802647	Costea	KY	Sep.	
26	US	1885904	Costea	TX	Oct.	
27	US	329	Costea	MO	Oct.	
61	MO	6013115	Brant	MO	Oct.	10
62	MO	1757520	Brant	MO	Oct.	4
63	MO	5387653	Skykora	OK	Oct.	4
66	MO	4610390	Henderson	MO	Oct.	12
67	MO	4074031	Brant	MO	Oct.	12
68	MO	5074499	Jacobs	MO	Oct.	10
Subtotal						100
Total achenes analyzed						405

Parasenegalia and *Pseudosenegalia* (Fabaceae): New Genera of the Mimosoideae

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Abstract. Recent studies have shown that the genus *Acacia* Mill. s.l. is polyphyletic, consisting of at least seven distinct groups of species. One of these groups, the proposed genus *Parasenegalia* Seigler & Ebinger, consists of seven species. We describe a new species, *Parasenegalia lundellii* Seigler & Ebinger, and make the following new combinations: *Parasenegalia muricata* (L.) Seigler & Ebinger, *Parasenegalia rurrenabaqueana* (Rusby) Seigler & Ebinger, *Parasenegalia santosii* (G. P. Lewis) Seigler & Ebinger, *Parasenegalia skleroxyla* (Tussac) Seigler & Ebinger, *Parasenegalia visco* (Lorentz ex Griseb.) Seigler & Ebinger, and *Parasenegalia vogeliana* (Steud.) Seigler & Ebinger. A second proposed genus, *Pseudosenegalia* Seigler & Ebinger, consists of two species: *Pseudosenegalia feddeana* (Harms) Seigler & Ebinger and *Pseudosenegalia riograndensis* (Atahuachi & L. Rico) Seigler & Ebinger. The species of *Parasenegalia* are widespread in the tropical areas of the Caribbean and scattered in Central and South America. Those of *Pseudosenegalia* are found in Bolivia. A series of morphological characteristics, as well as recent molecular data, separate these new genera from other members of *Acacia* subg. *Aculeiferum* Vassal. Although members of these two genera are distinct, previous taxonomic treatments have not dealt with them as separate units within *Acacia* subg. *Aculeiferum*. Lectotypes are designated for the following names: *Acacia concinna* Phil., *Acacia polyphylla* Clos, *Acacia riparia* Kunth var. *angustifoliola* Kuntze, *Parasenegalia visco* (Lorentz ex Griseb.) Seigler & Ebinger [≡ *Acacia visco* Lorentz ex Griseb.], and *Pseudosenegalia feddeana* (Harms) Seigler & Ebinger [≡ *Acacia feddeana* Harms].

Key words: *Acacia*, *Acacia* subg. *Aculeiferum*, *Acaciella*, *Mariosousa*, *Senegalia* s. str.

Recent morphological and genetic studies (Caccavari & Dome, 2000a, 2000b; Gómez-Acevedo et al., 2007) support the idea that the genus *Acacia* Mill. (Fabaceae, Mimosoideae), as generally accepted from the time of Bentham (1842, 1875, 1876), is polyphyletic. Accumulation of data from molecular studies has led to a better understanding of the probable relationships and divergence times within *Acacia* s.l., as well as the position of various components of this genus and other related plants within the Mimosoideae (Vassal, 1972; Maslin, 1988, 1999, 2015; Chappill & Maslin, 1995;

Clarke, 1995; Maslin & Stirton, 1997; Clarke et al., 2000; Maslin et al., 2003; Miller & Bayer, 2000, 2001, 2003; Rico Arce, 2001; Luckow et al., 2003; Miller et al., 2003a, 2003b, 2013; Murphy et al., 2003; Seigler et al., 2006a, 2006b; Gómez-Acevedo et al., 2007, 2010; Brown et al., 2008; Bouchenak-Khelladi et al., 2010; Miller & Seigler, 2012; Kyalangalilwa et al., 2013; Mishler et al., 2014; Boatwright et al., 2015). These studies confirmed that the genus *Acacia* s.l. is polyphyletic and should be separated into at least five genera (Fig. 1). The resulting genera (Table 1), for the most part, correspond to five currently recognized infrageneric taxa of *Acacia* s.l. The former *Acacia* subg. *Acacia* comprises the genus *Vachellia* Wight & Arn. (Seigler & Ebinger, 2005), and *Acacia* subg. *Phyllodineae* Ser. comprises the genus *Acacia* s.l. (Pedley, 1978, 1986; Maslin et al., 2003; Orchard & Maslin, 2003; Maslin, 2008). The former *Acacia* subg. *Aculeiferum* Vassal in *Acacia* is not monophyletic and has been split into three genera: *Acacia* sect. *Aculeiferum* Vassal as the genus *Senegalia* Raf. (Seigler et al., 2006a; Seigler & Ebinger, 2009, 2010), *Acacia* sect. *Filicinae* (Benth.) Pedley as the genus *Acaciella* Britton & Rose (Rico Arce & Bachman, 2006), and the genus *Mariosousa* Seigler & Ebinger (Jawad et al., 2000; Seigler et al., 2006b). However, an additional nine species of *Acacia* subg. *Aculeiferum* do not belong to any of these clades based on the latest phylogenetic results and are therefore now placed in the segregate genera. These species belong to two clades including a group of seven species similar to *Senegalia skleroxyla* (Tussac) Seigler & Ebinger (Fig. 1) and a second group of two species similar to *S. feddeana* (Harms) Seigler & Ebinger (Miller & Seigler, 2012, unpublished data). We propose two new genera *Parasenegalia* Seigler & Ebinger and *Pseudosenegalia* Seigler & Ebinger, respectively, to account for this phylogenetic history.

Several morphological features separate *Senegalia* s. str., *Acaciella*, *Mariosousa*, *Parasenegalia*, and *Pseudosenegalia*. Only *Senegalia* s. str. species have prickles, which are found on all species of this group, although they may be missing on individual specimens. Prickles are never found on *Mariosousa*, *Acaciella*, *Pseudosenegalia*, and *Parasenegalia* species. Only species of *Acaciella* consistently lack petiolar glands, although they are often missing on specimens of *M. acatlensis* (Benth.) Seigler & Ebinger, *M. salazarii* (Britton & Rose) Seigler & Ebinger, and *M. millefolia* (S. Watson) Seigler & Ebinger. Further, *Acaciella* species have stamens that dry to a pink-rose color and persistent floral bracts, even into fruiting condition in many species. *Parasenegalia*, *Mariosousa*, and many species of *Senegalia* s. str. have anther glands, but they are absent from species of *Acaciella* and *Pseudosenegalia*.

In the present study, we have examined characters of species phenetically similar to *Senegalia skleroxyla* and those similar to *S. feddeana*, herein described as the new genera *Parasenegalia* and *Pseudosenegalia*. Taxa of these two genera are unarmed, erect shrubs, small trees, or lianas with relatively unspecialized petiolar glands, and with flowers in cylindrical spikes or globose heads. The seven taxa of *Parasenegalia* occur from Hispaniola and Central America to Bolivia and Brazil. The two species of *Pseudosenegalia* are found in Bolivia. *Pseudosenegalia* species can be distinguished from *Parasenegalia* species by the extremely small size of the leaflets, the presence of short shoots, and the absence of anther glands. Although both *Parasenegalia* and *Pseudosenegalia* are morphologically distinct, previous taxonomic treatments have not dealt with them as separate units within *Acacia* subg. *Aculeiferum* (Bentham, 1875; Standley, 1922; Britton & Rose, 1928).

I. Parasenegalia Seigler & Ebinger, gen. nov. TYPE: *Acacia skleroxyla* Tussac, Fl. Antill. 1: 146–148, pl. 21. 1808 [1808–1813] [≡ *Parasenegalia skleroxyla* (Tussac) Seigler & Ebinger].

Trees, shrubs, or lianas, some to 25 m; twigs not flexuous, terete or nearly so; short shoots absent; prickles and stipular spines absent. Leaves alternate, bipinnate; stipules small, linear, symmetrical, herbaceous, tardily deciduous to persistent, rarely absent; petioles adaxially grooved, 10–50 mm long; petiolar glands present, sessile, solitary; rachis adaxially grooved, usually with a gland between some pairs of pinnae; pinnae 3 to 20 pairs/leaf, opposite; paraphyllidia present or absent; leaflets 7 to 65 pairs/pinna, linear to oblong, 1 to 5 veins from the base, glabrous to puberulent, midvein subcentral to submarginal. Inflorescence a globose head or cylindrical spike, solitary to small clusters in leaf axis or in large pseudoracemes or pseudopanicles of globose heads. Flowers bracteate, sessile, actinomorphic, sympetalous, 5-merous, with a basal copular nectariferous disk; stamens 40 to 140, distinct, attached along the side of the nectariferous disk, exserted; anthers small, dorsifixed, dehiscing vertically, with a small stalked gland usually present; ovary mostly sessile to subsessile (rarely with a stipe to 1.6 mm long); style filiform; stigma filiform. Legumes straight to slightly

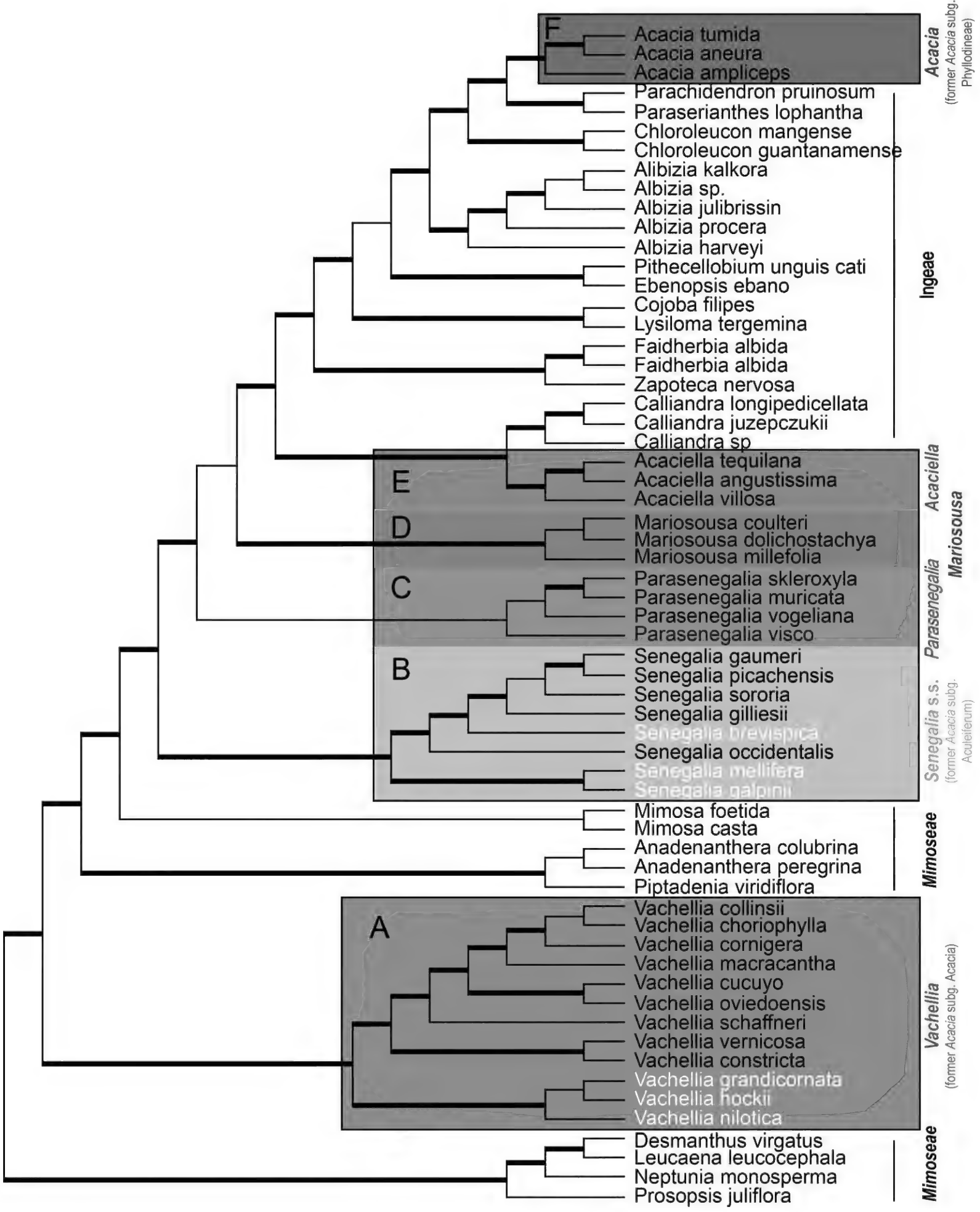

Figure 1. A redrawn figure from Miller and Seigler (2012), presenting topologies of a Bayesian tree without branch lengths. The three boxes indicate the three subgenera of *Acacia* s.l. Shaded groupings indicate segregate genera. Bold lines indicate Bayesian posterior probabilities above 95%.

curved, flattened, oblong, eglandular, dehiscing along both sutures (sometimes tardily so). Seeds uniseriate, not surrounded by pulp, ovoid to ellipsoid, flattened, sometimes with a marginal wing; pleurogram sometimes present, sometimes covering most of the seed.

Habitat and distribution. Occurring in tropical areas of the New World, *Parasenegalia* is comprised of three species restricted to the Caribbean, one in Belize and Guatemala, and three scattered in South America.

Table 1. Current status of generic names applied to higher-level monophyletic units of *Acacia* s.l.

Genus, post retypification (2005)	Pedley, 1978	Pedley, 1986	Generalized distribution
Acacia	*Acacia* subg. *Phyllodineae*	*Racosperma* Mart.	Australia, Pacific region
Vachellia	*Acacia* subg. *Acacia* (type *A. nilotica* (L.) Willd. ex Delile)	*Acacia*	Americas, Africa, Asia
Senegalia	*Acacia* subg. *Aculeiferum*	*Senegalia* sect. *Senegalia*	Americas, Africa, Asia
Acaciella	*Acacia* subg. *Aculeiferum*. sect. *Filicineae*	*Senegalia* sect. *Filicinae* (Benth.) Pedley	Americas
Mariosousa	*Acacia* subg. *Aculeiferum* "coulteri group"	*Senegalia* sect. *Senegalia*	North America
Parasenegalia	*Acacia* subg. *Aculeiferum* "skleroxyla" group	*Senegalia* sect. *Senegalia*	Americas
Pseudosenegalia	*Acacia* subg. *Aculeiferum* p.p.	*Senegalia* sect. *Senegalia*	Bolivia

Taxonomic Key to Species of *Parasenegalia*

1. Inflorescence a cylindrical spike.
   2. Leaflets 30 to 65 pairs/pinna; distance between leaflet pairs 0.7–1.6 mm (Dominican Republic & Haiti) ..... *P. skleroxyla* (Tussac) Seigler & Ebinger
   2′. Leaflets 7 to 31 pairs/pinna; distance between leaflet pairs 1.4–9.5 mm.
      3. Leaflets 1.8–3.2 mm wide; distance between leaflet pairs 1.4–4 mm; leaflet margins not revolute (Central America) ..... *P. lundellii* Seigler & Ebinger
      3′. Leaflets 4–11.3 mm wide; distance between leaflets pairs 3.8–9.5 mm; leaflet margins slightly revolute (Caribbean) ..... *P. muricata* (L.) Seigler & Ebinger
1′. Inflorescence a globose to subglobose head.
   4. Petiolar gland columnar, the apex 0.3–0.5 mm across; inflorescence receptacle elongated (Brazil) ..... *P. santosii* (G. P. Lewis) Seigler & Ebinger
   4′. Petiolar gland sessile, not columnar, the apex mostly more than 0.6 mm across; inflorescence receptacle not elongated, usually subglobose to globose.
      5. Leaflets 3–7 × 0.8–2.1 mm; distance between leaflet pairs 0.8–2.1 mm; leaflet midveins bluish purple beneath (South America) ..... *P. visco* (Lorentz ex Griseb.) Seigler & Ebinger
      5′. Leaflets 7–20 × 2.2–8.5 mm; distance between leaflet pairs 2.5–7 mm; leaflet midveins not bluish purple.
         6. Inflorescence 6.5–10 mm across; 6 to 9 pinna pairs/leaf (Bolivia, Peru) ..... *P. rurrenabaqueana* (Rusby) Seigler & Ebinger.
         6′. Inflorescence 9–14 mm across; 3 to 6 (7) pinna pairs/leaf (Caribbean) ..... *P. vogeliana* (Steud.) Seigler & Ebinger

1. Parasenegalia lundellii Seigler & Ebinger, sp. nov. TYPE: Belize. Toledo: western Bladen Nature Preserve in the limestone hills just S of Bladen River, 380 m, 16°30′N, 88°54′W, 30 Apr. 2002, *S. W. Brewer & M. Rejmanek 1113* (holotype, ILL!). Figure 2.

Diagnosis. *Parasenegalia lundellii* Seigler & Ebinger is similar to *P. muricata* (L.) Seigler & Ebinger by the flowers and inflorescences that are nearly identical in shape and size, but it is distinguished by the smaller leaflets (1.8–3.2 mm wide vs. 4–11.3 mm wide in *P. muricata*) that are not revolute at the margins and the fruits that are mostly wider (23–35 mm wide vs. 15–24 mm wide in *P. muricata*). *Parasenegalia lundellii* is the only species of this genus that probably lacks stipules.

Tree to 12 m tall; bark brown, smooth to shallowly flat ridged, with prominent horizontally elongated lenticels; twigs dark purplish brown, not flexuous, terete, glabrous to lightly puberulent; short shoots absent; prickles absent. Leaves alternate, 45–140 mm long; stipules absent; petiole adaxially grooved, 15–40 mm long, glabrous to lightly puberulent; petiolar gland usually solitary, located just below the lowermost pinna pair, sessile, oval to orbicular, 0.6–1.8 mm long, apex flattened to depressed, glabrous; rachis adaxially grooved, 30–120 mm long, puberulent, an oval gland 0.4–1.1 mm across between the uppermost 1 to 2 (rarely all) pinna pairs, apex flattened to depressed, glabrous; pinnae 5 to 10 pairs/leaf, 55–115 mm long, 6–20 mm between pinna pairs; paraphyllidia 0.2–0.5 mm long, mostly absent; petiolule 2–5 mm long; leaflets 15 to 30 pairs/pinna, opposite, 1.4–4 mm between leaflet pairs, oblong to narrowly lanceolate, 6–15 × 1.8–3.2 mm, glabrous or nearly so, lateral veins obvious, 3 to 5 veins from the base, base oblique, obtuse to truncate on one side, margins lightly ciliate and not revolute, apex obtuse, midvein submarginal. Inflorescence a loosely 75- to 180-flowered cylindrical spike, 60–110 × 10–15 mm, 1 to 2 from the leaf axils; peduncles 6–20 × 0.8–1.2 mm, puberulent; receptacle not enlarged; invo-

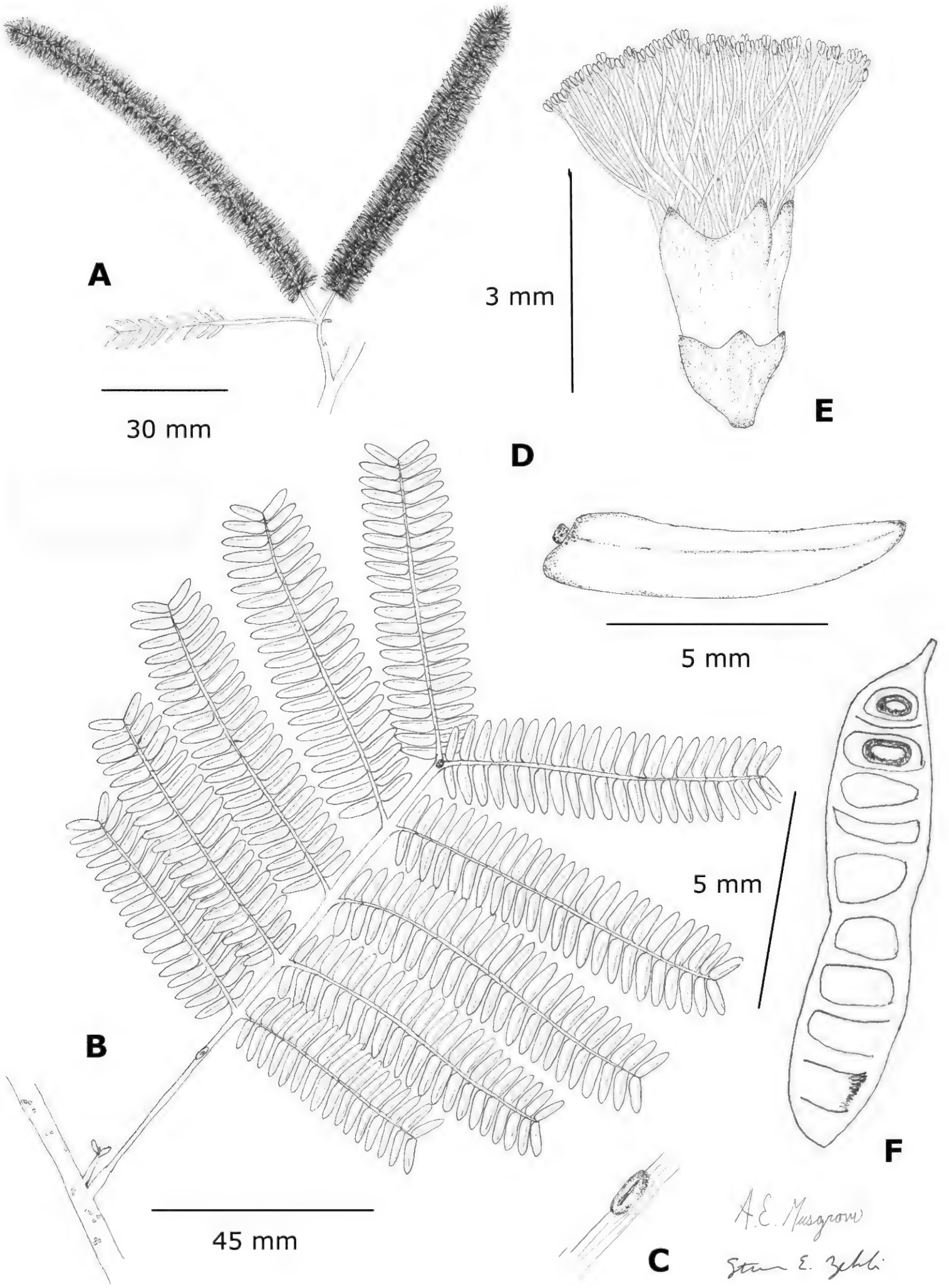

Figure 2. *Parasenegalia lundellii* Seigler & Ebinger. —A. Inflorescences. —B. Leaf. —C. Petiolar gland. —D. Leaflet, abaxial surface. —E. Flower. —F. Fruit. A, E from *Lundell & Contreras 19276* (NY); B–D from *Contreras 10264* (LL); F from *Proctor 35963* (MO).

lucre absent; floral bracts linear, 0.3–0.7 mm long, puberulent, early deciduous. Flowers sessile, white to cream (yellowing with age); calyx 5-lobed, 0.9–1.5 mm long, lightly puberulent; corolla 5-lobed, 1.6–2.6 mm long, lightly puberulent, lobes 1/3 the length of the corolla; stamens 60 to 90; stamen filaments 4.7–6.2 mm long, distinct; anther glands present; ovary glabrous, sessile to subsessile, the stipe to 0.2 mm

long. Legumes straight, flattened, not constricted between the seeds, oblong, 75–160 × 23–35 mm, coriaceous, lightly transversely striate, glabrous, eglandular, dehiscent along both sutures; stipe 3–7 mm long; apex obtuse, not beaked; seeds uniseriate, no pulp, dark brown, oval, strongly flattened and narrowly winged, 12–14 × 12–14 mm, oval, smooth; pleurogram not seen.

Etymology. This species honors C. L. Lundell (1907–1994), who collected extensively and studied plants of Belize and Guatemala as well as Texas, his native state. He was interested in Maya culture and archaeology and was the discoverer of the ancient city of Calakmul, which had been hidden in the jungle for 1000 years.

Habitat and distribution. *Parasenegalia lundellii* has been collected from semi-evergreen tropical forest from sea level to 500 m in Belize and Guatemala in Central America.

Phenology. *Parasenegalia lundellii* flowers from March to May.

IUCN Red List category. *Parasenegalia lundellii* is assessed as Data Deficient (DD) at this time (IUCN, 2001). This species is apparently rare and is known from fewer than 10 specimens from lowland Belize and Guatemala, suggesting that it may at least be Vulnerable (VU), perhaps Endangered (EN).

Discussion. *Parasenegalia lundellii* is morphologically most similar to *P. muricata*. The leaflets of *P. lundellii* seldom exceed 10 mm in length and never exceed 4 mm in width. The leaflet margins are not revolute. In contrast, those of *P. muricata* are 8–20 mm long and 4–11.3 mm wide, and have slightly revolute margins.

Paratypes. BELIZE. **Toledo:** Bladen Nature Preserve, S of Bladen River, 380 m, 29 Apr. 2002, *S. W. Brewer & M. Rejmanek 1099* (ILL); Bladen Nature Preserve, W of Quebrada de Oro, 380 m, 10 May 2002, *S. W. Brewer & M. Rejmanek 1179* (ILL); Bladen Nature Preserve, W of Quebrada de Oro, 380 m, 10 May 2002, *S. W. Brewer & M. Rejmanek 1187* (ILL); Bladen Nature Preserve, W of Quebrada de Oro, 370 m, 12 May 2002, *S. W. Brewer & M. Rejmanek 1211* (ILL); vic. of Sapote Camp, 6.5 mi. W of Medina Bank, 23–27 Apr. 1976, *G. R. Proctor 35963* (MO). GUATEMALA. **Izabal:** Puerto Méndez, 12 Sep. 1970, *E. Contreras 10264* (CAS, LL, MO). **Petén:** La Cumbre, W of km 141/142, 10 May 1975, *C. L. Lundell & E. Contreras 19276* (NY).

2. Parasenegalia muricata (L.) Seigler & Ebinger, comb. nov. Basionym: *Mimosa muricata* L., Syst. Nat., ed. 2: 1311, 1504. 1759. *Acacia muricata* (L.) Willd., Sp. Pl., ed. 4 [Willdenow] 4(2): 1058. 1806. *Senegalia muricata* (L.) Britton & Rose, N. Amer. Fl. 23(2): 113. 1928. TYPE: "*Mimosa inermis, foliis bipinnatis, parialibus quelque jugis, propiis, multijugis, floribus spicatis, caule muricato,*" tab. 11 illustrated by J. Burman in C. Plumier, Pl. Amer. 1: 6. 1755 (lectotype, designated by Howard, 1988: 341). Figure 3.

Acacia nudiflora Willd., Sp. Pl., ed. 4 [Willdenow] 4(2): 1058. 1806. TYPE: Virgin Islands. "Danish America" (holotype, B-Willd.! [barcode] B 19130-01 0; isotypes, P! [bc] P00396680, P! [bc] P03102816).

Acacia rohriana DC., Prodr. [A. P. de Candolle] 2: 457. 1825, as "*Rohriana*," replacement name for *Mimosa nigricans* Vahl, Eclog. Amer. 3: 37, pl. 29. 1807, nom. illeg., non *Mimosa nigricans* Labill., Nov. Holl. Pl. 2: 88, pl. 238. 1806. TYPE: "Habitat in America meridionali," s.d., *J. P. B. von Rohr s.n.* (holotype, C [image seen] [barcode] C10011408, C photo at F).

Large shrub or small tree to 15 m tall; bark dark brown, shallowly fissured; twigs dark reddish brown to dark purple, not flexuous, terete, glabrous to densely puberulent; short shoots absent; prickles absent. Leaves alternate, 50–165 mm long; stipules dark brown, narrowly triangular, symmetrical, flattened, straight, herbaceous, 0.6–1.6 mm long, 0.4–0.9 mm wide near the base, puberulent, tardily deciduous; petiole shallowly adaxially grooved, 10–40 mm long, glabrous to puberulent; petiolar gland solitary, located just below the lowermost pinna pair, sessile, orbicular to oblong, 1.4–3.1 mm long, apex bulbous and asymmetrical, sometimes depressed, glabrous; rachis shallowly adaxially grooved, 40–130 mm long, usually puberulent, an orbicular gland 0.7–1.8 mm across between most pinna pairs, apex depressed, glabrous; pinnae 3 to 7 pairs/leaf, 45–120 mm long, 5–22 mm between pinna pairs; paraphyllidia absent; petiolule 2.1–6.1 mm long; leaflets 8 to 24 pairs/pinna, opposite, 3.8–9.5 mm between leaflet pairs, oblong, (7)8–20 × 4–11.3 mm, glabrous, lateral veins obvious, 2 to 5 veins from the base, base oblique and obtuse on one side, margins slightly revolute, not ciliate, apex obtuse, midvein subcentral. Inflorescence a loosely 145- to 200-flowered cylindrical spike, 70–190 × 13–18 mm, 1(2) from the leaf axil; peduncles 0.1–2.5 × 0.9–1.7 mm, densely puberulent; receptacle not enlarged, elongated; involucre absent; floral bracts spatulate, 0.5–0.9 mm long, puberulent, early deciduous. Flowers sessile, white to cream-colored; calyx 5-lobed, 1–1.6 mm long, puberulent; corolla 5-lobed, 1.8–3.1 mm long, puberulent, lobes 1/4–1/2 the length of the corolla; stamens 100 to 140; stamen filaments 5.5–7.5 mm long,

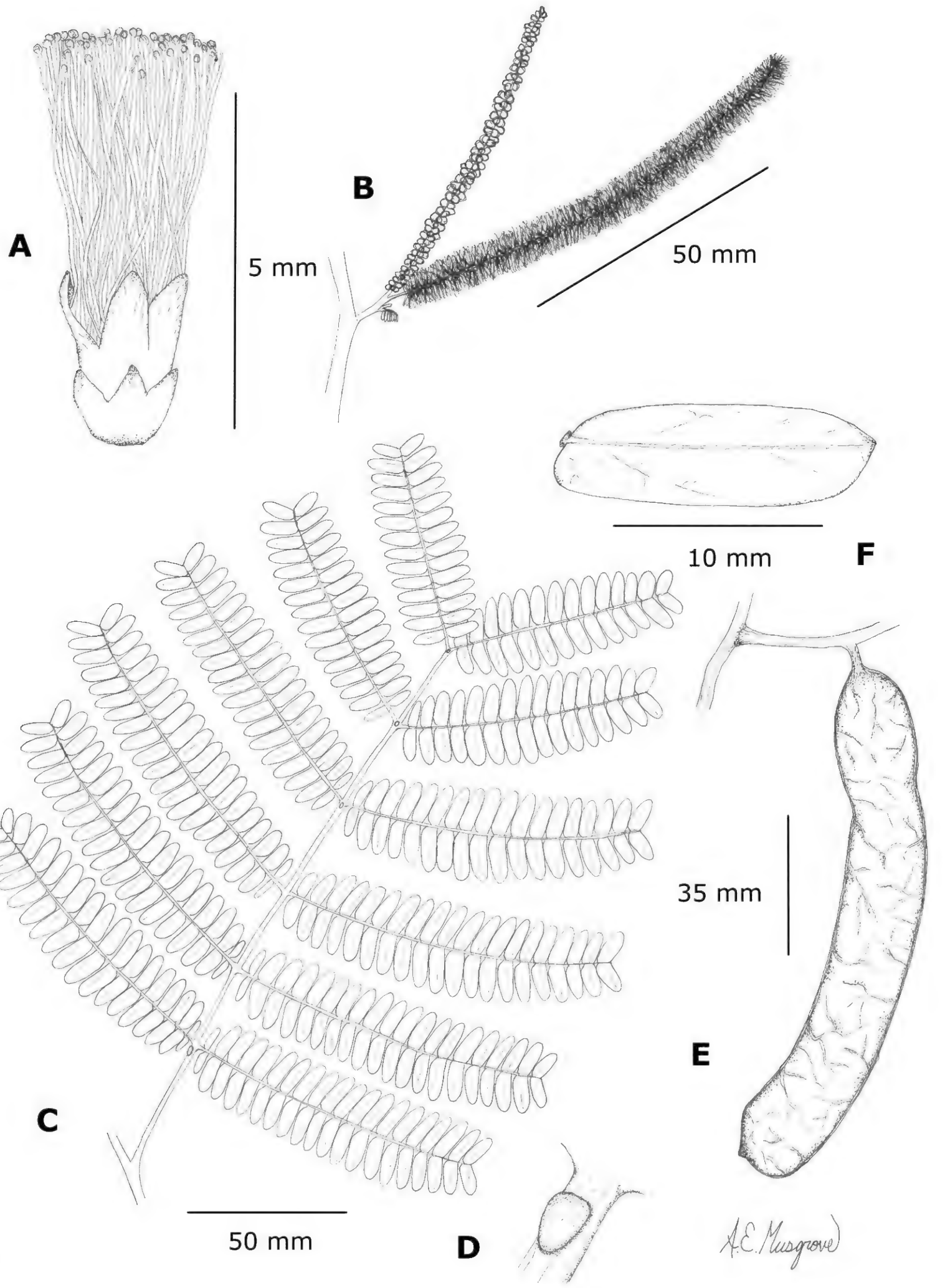

Figure 3. *Parasenegalia muricata* (L.) Seigler & Ebinger. —A. Flower. —B. Inflorescences. —C. Leaf, adaxial view. —D. Petiolar gland. —E. Fruit. —F. Leaflet, abaxial view. A, B from *Woodbury s.n.* [Nov. 1970] (NY); C, D from *Box 794* (F), E, F from *Smith 10476* (NY).

distinct; anther glands present; ovary glabrous, sessile. Legumes straight, flattened, not constricted between the seeds, oblong, 50–170 × 15–24 mm, coriaceous, transversely striated, glabrous, eglandular, dehiscent along both sutures; stipe 5–9 mm long; apex obtuse, short-beaked; seeds uniseriate, no pulp, dark brown, oval to elliptic, strongly flattened, winged, 10.5–14.5 × 8–10 mm, smooth;

pleurogram broadly U-shaped to nearly circular, 5–8 mm across.

Habitat and distribution. *Parasenegalia muricata* is a species of coastal deserts, dry thickets, cactus scrub forests, wooded hillsides, and plains from sea level to 500 m in the Caribbean. It has been reported from Dominica, Dominican Republic, Puerto Rico, Virgin Islands, and Lesser Antilles.

Phenology. *Parasenegalia muricata* flowers from April to June.

Local names and uses. Local names include spineless acacia, amarat, tamarindo cimarrón, tantacayo, and tender á caillou (Rico Arce, 2007). Wood has sometimes been used for construction.

IUCN Red List category. *Parasenegalia muricata* is Data Deficient (DD) at this time (IUCN, 2001). The species is relatively common in Puerto Rico, the Virgin Islands, and several of the other Lesser Antilles. The limited habitat suggests that the species should be evaluated.

Discussion. *Parasenegalia muricata* is a common species of dry, wooded hillside and cactus scrub forest throughout much of the Caribbean. This taxon has the largest leaflets of the species in the genus *Parasenegalia*, being 8–20 mm long and 4–11.3 mm wide, and with slightly revolute margins. Though *P. lundellii* sometimes has leaflets exceeding a length of 10 mm, the leaflets are narrower (never exceeding 4 mm), and the leaflet margins are not slightly revolute.

Specimens examined. DOMINICAN REPUBLIC. **Barahona:** Las Salmas, 17 Aug. 1946, *R. A. Howard & E. S. Howard 8402* (B). **Santo Domingo:** Santo Domingo, 8 June 1887, *Eggers 2393* (US). LESSER ANTILLES. **Antigua:** woodlands, 9 May 1937, *H. E. Box 794* (F); Falmouth Peak (Sugarloaf), 200–380 m, 9 Apr. 1956, *A. C. Smith 10476* (NY). **Dominica:** St. Joseph Parish, betw. Layou & St. Joseph, 26 Feb. 1997, *S. R. Hill & L. R. Phillippe 28956* (ILLS). **Guadeloupe:** Basse-Terre, Deshaies, 28 July 1980, *S. Barrier 2381* (NY); Apr. 1893, *P. Duss 3043* (NY). **Martinique:** 1884, *P. Duss 1159* (F, MO, NY). PUERTO RICO. Fajardo, 15 Sep. 1981, *D. Alain, P. Liogier, L. F. Martorell & E. Solano 32279* (MO); Yabucoa, Punta Guayanés, 6 Dec. 1992, *F. Axelrod & I. Sastre 5486* (MO); Yabucoa, Punta Guayanés, 12 May 1991, *F. Axelrod, J. Turnquist, A. Axelrod & B. Axelrod 2417* (MO); Aquirre, 14 Feb. 1922, *N. L. Britton, E. G. Britton & M. S. Brown 6023* (NY); Culebra Island, 3–12 Mar. 1906, *N. L. Britton & W. M. Wheeler 160* (F, NY); Vieques Island, 3 June 1978, *F. R. Fosberg 57546* (MO); near shore, Ceiba Playa, 18 Feb. 1926, *H. A. Gleason & M. T. Cook K-18* (NY); near Fajardo, 20 m, 19 Aug. 1963, *A. Liogier 10182* (F, NY); Isla de Vieques, slope of Cerro Matías, 100 m, *G. R. Proctor 48026* (FTG); Camp Santiago, Section Lima, 21 May 1993, *R. Rose & J. Salguero 675* (MO); Punta Guayanés, Las Palmas, 6 June 2006, *D. S. Seigler, J. T. Miller, C. Riggins & F. S. Axelrod 14546* (ILL), *14548* (ILL), *14549* (ILL), *14550* (ILL); Punta Guayanés, Yabucoa, 5 July 1999, *D. S. Seigler, F. S. Axelrod & A. Salywon 14600* (ILL), *14604* (ILL); Rte. 712 betw. La Plena & Carmen, 12 June 1991, *C. M. Taylor 10439* (MO, NY); Fajardo, 4 May 1885, *I. Urban 1276* (CM, YU); Yabucoa, 8 Sep. 1886, *I. Urban 4932* (CM, F, HBG, MO, NY); Punta Guayanés de Yabucoa, 16 May 1967, *R. O. Woodbury s.n.* (NY); Vieques, Nov. 1970, *R. O. Woodbury s.n.* (MO, NY). VIRGIN ISLANDS. **Beef Island:** E end of airstrip, 5 Mar. 1966, *W. G. D'Arcy 838* (FLAS, MO). **Norman Island:** Treasure Point, 24 Mar. 1979, *D. S. Correll & H. B. Correll 50481* (FTG). **Saint Johns:** Hansen Bay, 18 Aug. 1987, *P. Acevedo-R., A. Reilly & M. Davis 1802* (NY); Reef Bay, 55 m, Mimo, 26 Aug. 1987, *P. Acevedo-R., A. Reilly & J. Earhart 2036* (NY); Saint Jan, wooded hillside, 10–12 Feb. 1913, *N. L. Britton & J. A. Shafer 513* (NY); Saint John, 500 ft., 29 May 1940, *L. R. Holdridge 133* (NY); Mariás Bluff, 16 June 1984, *G. T. Prance, S. A. Mori, J. Earhart, A. E. Prance & R. O. Woodbury 29293* (FTG, NY); Bordeaux Mtn., 10 Nov. 1984, *S. A. Mori, R. O. Woodbury & J. Matuszak 17056* (NY). **Saint Thomas:** Fortuna Quarter, 140 m, 26 Aug. 1992, *P. Acevedo R., A. Siaca & A. Reilly 5192* (NY); hillside thicket, 31 Jan.–4 Feb. 1913, *N. L. Britton, E. G. Britton & J. A. Shafer 33* (NY); Cowell's Battery, 14 Jan. 1876, *von Eggers s.n.* (MO, NY, WIS); Signal Hill, 300 m, May 1881, *von Eggers 304* (HBG). **Tortola:** Sage Mtn., 600 m, 28 July 1944, *J. S. Beard 335* (MO); rd. to Sea Cow Bay, 13–17 Feb. 1913, *N. L. Britton & J. A. Shafer 677* (NY); E of Road Town on Belleview Rd., 80 m, 13 Apr. 1965, *W. G. D'Arcy 9A* (MO); Bell Vue, 19 Apr. 1919, *W. C. Fishlock 421* (NY); Sage Mtn., 20 July 1954, *E. L. Little, Jr. 16384* (NY); **Virgin Gorda:** North Sound, 29 Oct. 1918, *W. C. Fishlock 29* (NY); 21 June 1969, *R. O. Woodbury s.n.* (MO, NY).

3. Parasenegalia rurrenabaqueana (Rusby) Seigler & Ebinger, comb. nov. Basionym: *Acacia rurrenabaqueana* Rusby, Mem. New York Bot. Gard. 7: 255. 1927. *Senegalia rurrenabaqueana* (Rusby) Seigler & Ebinger in Seigler et al., Phytologia 88(1): 72. 2006. TYPE: Bolivia. Beni: Rurrenabaque, 1000 ft., 25 Jan. 1922, *O. E. White 2043* (holotype, NY! [barcode] NY00001544; isotypes, GH! , K not seen, US! [bc] US00000606, US01014372). Figure 4.

Climbing shrub or small tree to 6 m tall; bark not seen; twigs light reddish to yellowish brown, not flexuous, terete, puberulent; short shoots absent; prickles absent. Leaves alternate, 60–200 mm long; stipules dark brown, linear, symmetrical, flattened, straight, herbaceous, 2.5–7.5 mm long, 0.2–0.4 mm wide near the base, pubescent, tardily deciduous; petiole adaxially grooved, 18–35 mm long, densely puberulent; petiolar gland solitary, located on the upper half of the petiole commonly near the lowermost pinna pair, sessile, oval to orbicular, 0.8–2.2 mm across, apex flattened to shallowly cup-shaped, glabrous; rachis adaxially grooved, 40–170 mm long, usually densely puberulent, an oval gland

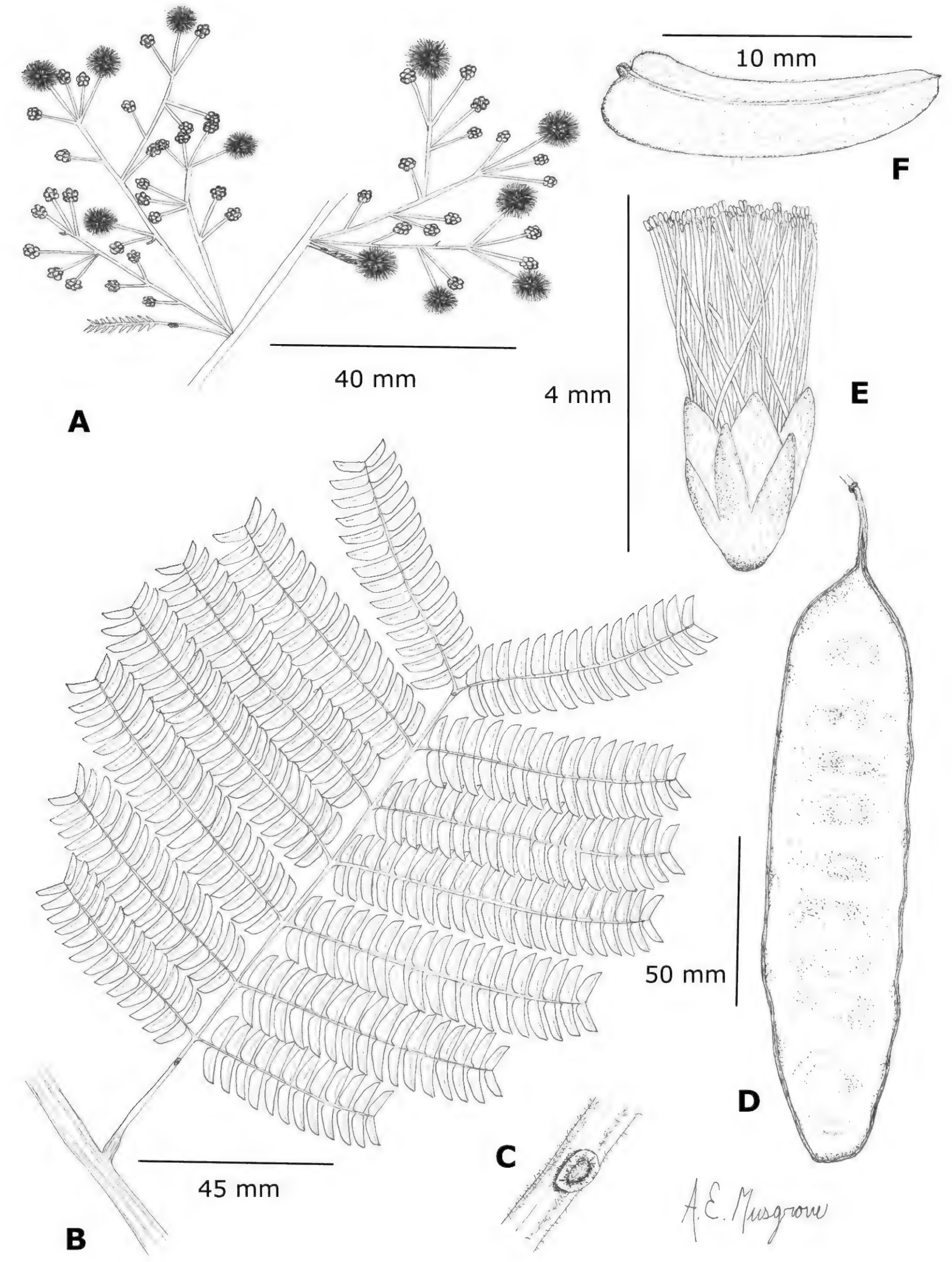

Figure 4. *Parasenegalia rurrenabaqueana* (Rusby) Seigler & Ebinger. —A. Portion of pseudopaniculate cluster. —B. Leaf, adaxial view. —C. Petiolar gland. —D. Fruit. —E. Flower. —F. Leaflet, abaxial view. A, D, E from *Nee 40046* (NY); B, C, F from *Nee 47545* (ILL).

0.8–1.8 mm across between the uppermost 1 to 2 pinna pairs, apex flattened to depressed, glabrous; pinnae 6 to 9 pairs/leaf, 55–95 mm long, 8–17 mm between pinna pairs; paraphyllidia 0.5–1.1 mm long; petiolule 2–4 mm long; leaflets 13 to 30 pairs/pinna, opposite, 2.5–4.5 mm between leaflet pairs, oblong, 7–15 × 2.3–5.5 mm, appressed pubescent below and sometimes above, lateral veins obvious, 2 to 4 veins

from the base, base oblique, truncate on one side, margins ciliate, apex narrowly acute to acuminate, midvein submarginal. Inflorescence a densely 15- to 35-flowered globose head 6.5–10 mm across, in terminal pseudopaniculate clusters, the main axis to 450 mm long; peduncles 2–12 × 0.3–0.5 mm, densely puberulent; receptacle not enlarged, slightly elongated; involucre 1 to 2 small bracts scattered along the upper half of the peduncle, early deciduous; floral bracts spatulate, 0.3–0.8 mm long, puberulent, early deciduous. Flowers sessile, creamy white; calyx 5-lobed, 0.9–1.6 mm long, puberulent; corolla 5-lobed, 1.7–2.4 mm long, puberulent, lobes 1/3 the length of the corolla; stamens 40 to 80; stamen filaments 4–5.5 mm long, distinct; anther glands present; ovary glabrous, the stipe to 0.6 mm long. Legumes straight, flattened, not constricted between the seeds, oblong, 90–180 × 22–35 mm, chartaceous, transverse striate, lightly appressed pubescent, eglandular, dehiscent along both sutures; stipe 6–15 mm long; apex obtuse, beaked; seeds uniseriate, no pulp, light to dark brown, nearly oval, strongly flattened, 6.5–8.5 × 5.5–7.5 mm, smooth; pleurogram U-shaped, 1.5–2.5 mm across.

Habitat and distribution. *Parasenegalia rurrenabaqueana* has been collected from dry semi-deciduous forests and seasonally flooded savannas, disturbed second-growth forest, and thickets from near sea level to 700 m in Bolivia and Peru.

Phenology. *Parasenegalia rurrenabaqueana* flowers from November through March.

IUCN Red List category. *Parasenegalia rurrenabaqueana* is assessed as Data Deficient (DD) at this time (IUCN, 2001). This species is relatively common in Bolivia and Peru, suggesting that the species may be of Least Concern (LC).

Discussion. *Parasenegalia rurrenabaqueana*, *P. visco*, and *P. santosii* are restricted to South America. The ranges of the first two species overlap geographically, but *P. rurrenabaqueana* is found below 700 m, whereas *P. visco* is found at higher elevations, between 750 and 3000 m. These two taxa are easily separated, as *P. visco* has smaller leaflets (3–7 × 0.8–2.1 mm) with a bluish midvein, while *P. rurrenabaqueana* has large leaflets (7–15 × 2.3–5.5 mm) and the midvein is not bluish purple. *Parasenegalia santosii* is only found in northeastern Brazil.

Specimens examined. BOLIVIA. **Beni:** Carretera Yucumo-Rurrenabaque, 235 m, 20–25 June 1989, *D. N. Smith, M. Buddensiek & V. García 13577* (MO, US). **La Paz:** Abel Iturralde, San Buenaventura, 190 m, 16 Dec. 2003, *A. Fuentes 6164* (ILL, MO); Guanay, 1800 ft., 14–16 Apr. 1926, *G. H. H. Tate 571* (NY). **Santa Cruz:** 5.5 km NE of Cotoca, 340 m, 28 Nov. 1990, *M. Nee 40046* (MO, NY); 13 km NE of Cotoca, 325 m, 18 Dec. 1992, *M. Nee 43143* (MO, NY); 7 km NW of Puerto Pailas, 300 m, 10 Feb. 1994, *M. Nee 44848* (MO, NY); 2.5 km NW of La Esperanza, 270 m, 26 Dec. 1997, *M. Nee 47532* (ILL, MO, NY); 8.2 km NE of La Esperanza, 265 m, 26 Dec. 1997, *M. Nee 47541* (ILL, MO, NY); 8.2 km NE of La Esperanza, 265 m, 26 Dec. 1997, *M. Nee 47545* (ILL, MO, NY); Puente Las Chacras on the Montero-Okinawa hwy., 275 m, 26 Dec. 1997, *M. Nee 47552* (ILL, MO, NY); Puente El Empalme, 10 km WSW of Colonia Okinawa, 250 m, 11 Jan. 1998, *M. Nee 47916* (ILL, MO, NY); Parque Nacional Amboro, 400 m, 22 Jan. 1988, *M. Nee & M. Saldias P. 36054* (MO, NY); Nuflo de Chávez, near San Julián, 274 m, 27 Feb. 2003, *L. Rico, T. Windsor-Shaw, A. McRobb, L. Arroyo & C. Roth 1406* (MO); Nuflo de Chávez, near San Julián, 370 m, 27 Feb. 2003, *L. Rico, T. Windsor-Shaw, A. McRobb, L. Arroyo & C. Roth 1413* (MO, NY). PERU. **Amazonas:** 14–15 km E of Bagua Chica on rd. to La Peca, 680–730 m, 12 June 1978, *A. Gentry, M. Dillon, J. Aronson & G. Diaz 22838* (F, MO). **Loreto:** Ivita, Km. 59, Pucallpa–Tingo Mária rd., 25 Mar. 1977, *A. Gentry, J. Revilla, D. A. Castaneda & D. Daly 18604* (MO); Fortaleza, near Yurimaguas, 140 m, Nov. 1932, *G. Klug 2784* (MO, NY, US). **Madre de Dios:** Parque Nacional del Manú, 350 m, 26 Aug. 1984, *R. Foster 9918* (MO, NY); 350 m, *Vargas 18656* (MO). **San Martín:** Juan Jui, Alto Río Huallaga, 400–800 m, Dec. 1935, *G. Klug 4196* (F, MO, NY, US); Alto Río Huallaga, 360–900 m, Dec. 1929, *L. Williams 6788* (F); Tarapoto, Dec. 1902, *E. Ule 6623* (HBG). **Ucayali:** Lago de Yarinacocha, 250 m, 27 Mar. 1981, *R. Vásquez & N. Jaramillo 1513* (ILL, MO).

4. Parasenegalia santosii (G. P. Lewis) Seigler & Ebinger, comb. nov. Basionym: *Acacia santosii* G. P. Lewis, Kew Bull. 51(2): 371–372. 1996. *Senegalia santosii* (G. P. Lewis) Seigler & Ebinger in Seigler et al., Phytologia 88(1): 72. [June] 2006. TYPE. Brazil. Bahia: 10–15 km along rd. Conquista to Anagé, caatinga, 22 Nov. 1972, *T. S. dos Santos 2488* (holotype, CEPEC not seen [9116]; isotype, K! [barcode] K00001438, CEPEC photo at K! [bc] K000091439, CEPEC photo at K [bc] K000091440). Figure 5.

Tree to 6 m tall; bark not seen; twigs light brown to light gray, not flexuous, terete, glabrous to lightly puberulent; short shoots absent; prickles absent. Leaves alternate, 45–90 mm long; stipules brown, linear to subulate, symmetrical, flattened, straight, coriaceous, 4–7 mm long, 0.4–0.8 mm wide near the base, glabrous, tardily deciduous to persistent; petiole shallowly adaxially grooved, 20–25 mm long, glabrous; petiolar gland solitary, located just below to between the lowermost pinna pair, short-columnar, apex 0.3–0.5 mm across, bulbous, oval, glabrous; rachis shallowly adaxially grooved, 20–70 mm long, lightly pubescent, an orbicular to short-columnar gland 0.2–0.5 mm across between some of the pinna

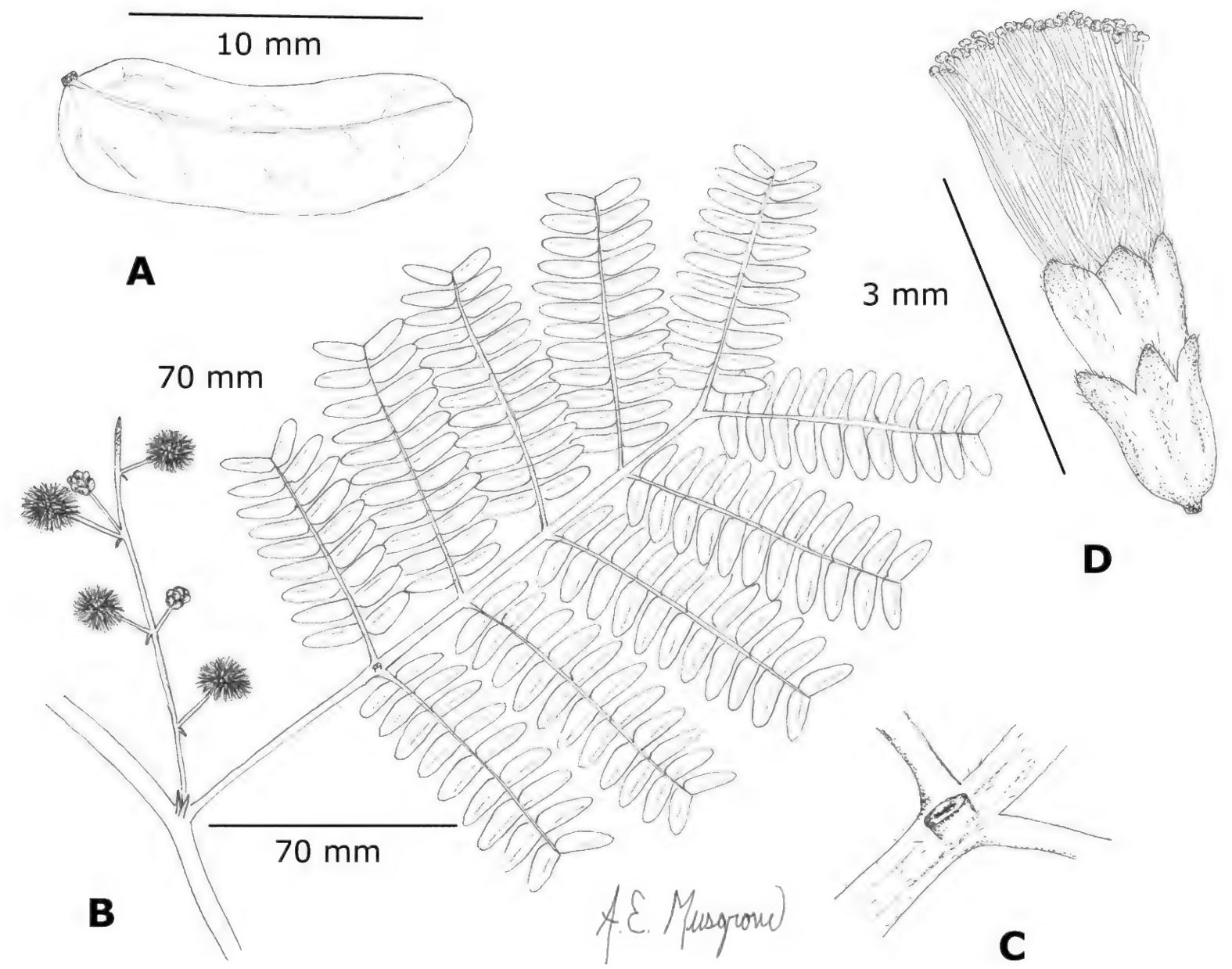

Figure 5. *Parasenegalia santosii* (G. P. Lewis) Seigler & Ebinger. —A. Leaflet, abaxial surface. —B. Branch with pseudoracemose cluster and leaf. —C. Petiolar gland. —D. Flower. A–D from *Magalhães 19492* (NY, RB 40434).

pair; pinnae 4 to 6 pairs/leaf, 35–85 mm long, 9–15 mm between pinna pairs; paraphyllidia 0.3–0.7 mm long; petiolule 3–6.5 mm long; leaflets 7 to 18 pairs/pinna, opposite, 2.5–6.5 mm between leaflet pairs, oblong to obovate, 7–16 × 2.5–4.9 mm, glabrous, lateral veins obvious, 2 to 4 veins from the base, base oblique, mostly truncate on one side, margins not ciliate, apex obtuse, midvein submarginal to subcentral. Inflorescence a densely 25- to 40-flowered globose to subglobose head 10–14 mm across, in terminal pseudopaniculate clusters, the main axis to 250 mm long; peduncles 5–13 × 0.3–0.6 mm, densely puberulent; receptacle not enlarged, distinctly elongated; involucre 1 to 3 bracts located along peduncle, one usually located just below the globose inflorescence, early deciduous; floral bracts spatulate, 0.8–1.2 mm long, puberulent, early deciduous. Flowers sessile, white; calyx 5-lobed, 1.3–1.9 mm long, puberulent; corolla 5-lobed, 2.3–3 mm long, puberulent, lobes 1/4 the length of the corolla; stamens 40 to 80; stamen filaments 5.8–7.5 mm long, distinct; anther glands present; ovary glabrous, sessile to subsessile, the stipe to 0.2 mm long. Legumes not seen; seeds not seen.

Habitat and distribution. *Parasenegalia santosii* is known from savannas from near sea level to 400 m in Bahia and Minas Gerais, Brazil.

Phenology. *Parasenegalia santosii* flowers from November through December.

IUCN Red List category. *Parasenegalia santosii* is assessed as Data Deficient (DD) at this time (IUCN, 2001). This species is apparently rare and only known from a few collections, the type and three others. Further, because of habitat destruction, this species may at least be Vulnerable (VU), perhaps Endangered (EN).

Discussion. We have only examined three specimens of *Parasenegalia santosii*, a photograph, and a drawing of the type of this taxon. Two specimens from Bahia were seen by V. Terra. One additional collection has been reported to represent this species by Barros and Morim (2014) from Brazil (Espírito

Santo, Aracruz, ES–445, Km. 10, fazenda Limoeiro, 19°40′36″S, 40°09′0″W, 4 Dec. 2014. *H. Cavalcante de Lima 7921* (RB RB612240 [barcode] RB00905083). We have only seen an image of this collection. This specimen differs in several characters from the original description for *P. santosii*, e.g., the number of leaflets/pinna (17 to 20) and the position of the petiolar gland (on the petiole below the lowermost pair of pinnae). It seems probable that this species is more widespread than previously thought. In any case, additional collections are required to establish the range of character variation and occurrence of the species.

Lewis (1996) suggested that *Parasenegalia santosii* (discussed as *Acacia santosii*) is closely related to *A. ambigua* Vogel (≡ *P. vogeliana* Seigler & Ebinger), a species from Hispaniola. *Parasenegalia santosii* is easily separated from other members of the genus with globose inflorescences by the elongated receptacle. This species also has a columnar petiolar gland, while other members of the genus have sessile petiolar glands. Although anther glands are reported as lacking (Lewis, 1996), they are present on specimen *M. Magalhães 19492* (NY).

Specimens examined. BRAZIL. **Bahia:** Guaratinga, 8 Dec. 1966, *R. P. Belém & R. S. Pinheiro 2748* (CEPEC); Prado, Estrada do camping, 31 Dec. 1979, *L. A. Mattos & H. S. Brito 703* (CEPEC). **Minas Gerais:** caatinga, rodovia Río Bahia, Km. 811, a 10 km de Itaobim, 380 m, 9 Dec. 1958, *M. Magalhães 19492* (NY, RB 40434).

5. Parasenegalia skleroxyla (Tussac) Seigler & Ebinger, comb. nov. Basionym: *Acacia skleroxyla* Tussac, Fl. Antill. 1: 146–148, tab. XXI [21]. 1808 [1808–1813]. *Senegalia skleroxyla* (Tussac) Seigler & Ebinger, Phytologia 91(1): 28. 2009. TYPE: Antilles. Santo Domingo (holotype, tab. XXI [21] in Tussac [1808]!). Figures 6, 7.

Tree to 20 m tall; bark gray to light brown, smooth; twigs light to dark purplish brown, not flexuous, terete, glabrous to lightly puberulent; short shoots absent; prickles absent. Leaves alternate, 60–160 mm long; stipules purplish brown, triangular, symmetrical, flattened, straight, herbaceous, 0.4–0.9 mm long, 0.3–0.7 mm wide near the base, puberulent, tardily deciduous; petiole flat to rarely adaxially grooved, 8–28 mm long, puberulent to rarely glabrous; petiolar gland solitary, located on the upper third of the petiole, usually just below the lowermost pinna pair, sessile, oval to orbicular, 0.7–1.8 mm across, apex flattened to depressed, glabrous; rachis flat to rarely adaxially grooved, 35–140 mm long, puberulent, an oval gland 0.4–1.3 mm across between the uppermost 1 to 7 pinna pairs, apex flattened to depressed, glabrous; pinnae (3) 5 to 16 pairs/leaf, 45–95 mm long, 5–10 mm between pinna pairs; paraphyllidia 0.1–0.3 mm long, usually absent; petiolule 0.7–2.2 mm long; leaflets 30 to 65 pairs/pinna, opposite, 0.7–1.6 mm between leaflet pairs, oblong, 4.5–9.5 × 0.9–2.1 mm, glabrous, lateral veins obvious, 1 to 3 veins from the base, base oblique, truncate on one side, margins not ciliate, apex acute to acuminate, midvein subcentral. Inflorescence a loosely 100- to 230-flowered cylindrical spike, 60–150 × 10–15 mm, 1 to 4 from the leaf axils; peduncles 6–25 × 0.8–1.3 mm, puberulent; receptacle not enlarged, elongated; involucre absent; floral bracts spatulate, 0.3–0.7 mm long, puberulent, early deciduous. Flowers sessile, white to cream (yellowing with age); calyx 5-lobed, 0.7–1.5 mm long, puberulent; corolla 5-lobed, 1.8–2.4 mm long, usually puberulent, lobes 1/4 the length of the corolla; stamens 40 to 80; stamen filaments 4.5–7 mm long, distinct to rarely slightly fused at the base; anther glands present; ovary glabrous, sessile to subsessile, the stipe to 0.2 mm long. Legumes straight, flattened, not constricted between the seeds, oblong, 75–160 × 13–25 mm, coriaceous, transversely striated, glabrous, eglandular, tardily dehiscent along both sutures; stipe 2–7 mm long; apex broadly acute to obtuse, short beaked; seeds uniseriate, no pulp, dark brown, oval to oblong, strongly flattened, narrowly winged, 8–12 × 6–8 mm, smooth; pleurogram U-shaped to circular, covering most of the seed.

Habitat and distribution. *Parasenegalia skleroxyla* is known from dry desert scrub, semi-dry forest, semi-arid pine forest, thorn-scrub thickets, disturbed second-growth forests, and thickets from sea level to 800 m in the Dominican Republic and Haiti.

Phenology. *Parasenegalia skleroxyla* flowers from March through August.

Local names. Local names include candelón, corbano, and taquito (Rico Arce, 2007).

IUCN Red List category. *Parasenegalia skleroxyla* is assessed as Data Deficient (DD) at this time (IUCN, 2001). This is a common tree of Hispaniola, suggesting that the species is of Least Concern (LC).

Discussion. A common tree endemic to the Dominican Republic and Haiti, *Parasenegalia skleroxyla* is sometimes confused with *P. muricata*. *Parasenegalia muricata*, however, has larger leaflets that exceed 10 mm in length, and are more than 4.5 mm wide. Also, *P. skleroxyla* has 30 to 65 leaflets/pinna, more than any other member of the genus *Parasenegalia*, other than *P. visco*, a species

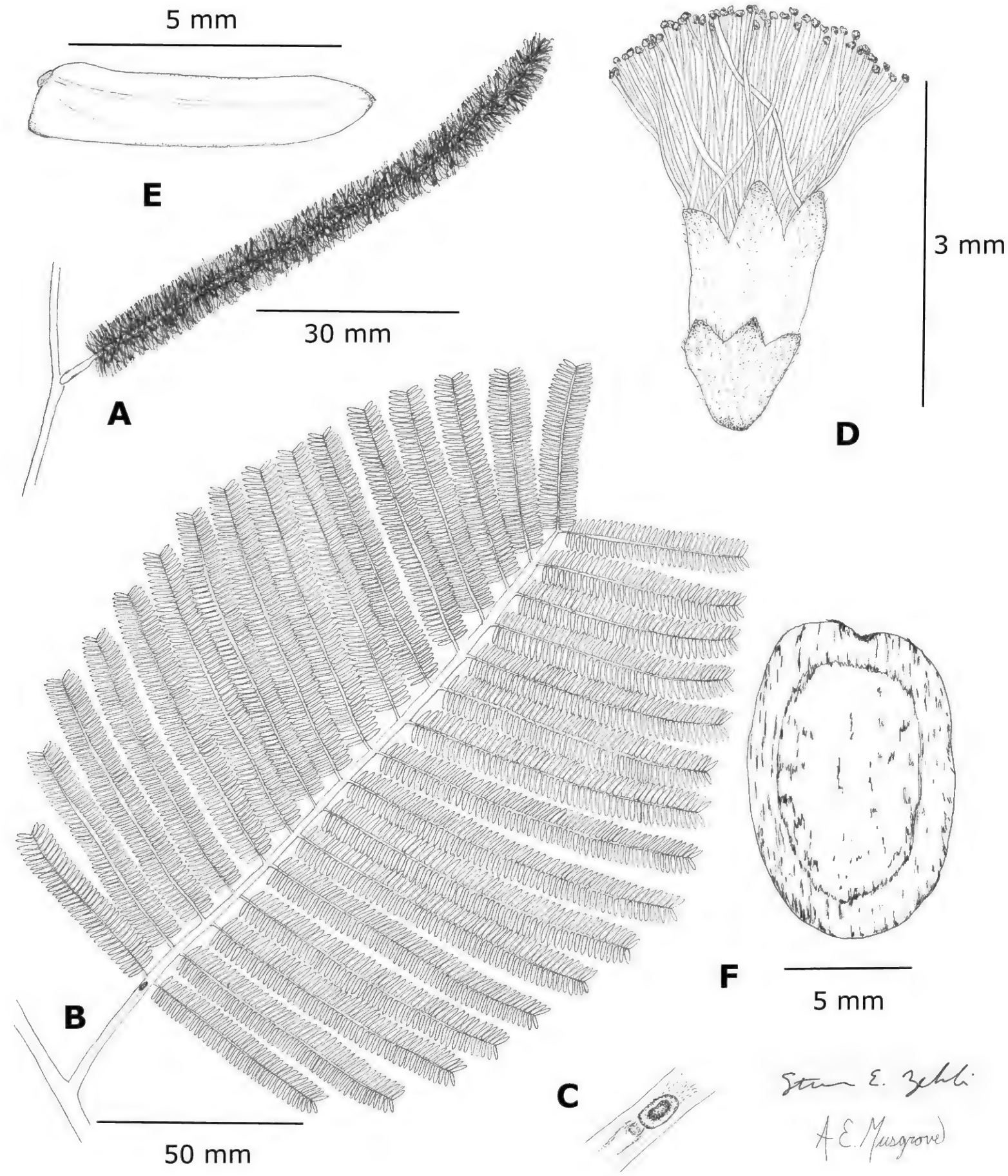

Figure 6. *Parasenegalia skleroxyla* (Tussac) Seigler & Ebinger. —A. Inflorescence. —B. Leaf, adaxial view. —C. Petiolar gland. —D. Flower. —E. Leaflet, abaxial view. —F. Seed. A from *Zanoni, Pimentel, García & Salazar 39331* (FLAS); B–F from *Leonard & Leonard 12617* (MO).

from southern South America with globose inflorescences. Barneby and Zanoni (1989) observed that the correct orthography of the specific epithet is *skleroxyla*, as used by Tussac (1808), not *scleroxyla*.

Specimens examined. DOMINICAN REPUBLIC. **Azua:** 4 km S of Barrreras, 100 m, 14 July 1988, *H. D. Clarke & R. García 28* (ILL, MO); 10 km en el trayecto Tabara Abajo-Barahona, 100–140 m, 30 June 1984, *R. García & N. Alba 38* (MO); Sierra Martín García, en el Poblado de Barrero, 175 m, 3 Sep. 1986, *R. García & J. Pimentel 1683* (MO); Azua, 9 Mar. 1965, *Bro. B. A. Lavastre 1942* (NY); 5 km S of Poblado de Barrero, 30 m, 12 Nov. 1985, *J. Pimentel, R. García & G. Caminero 320* (MO); 8 km S of Azua, 29 May 2006, *D. S. Seigler, J. T. Miller, C. Riggins, F. Axelrod & T. Clase 14503* (ILL); 8 km S of Azua, 29 May 2006, *D. S. Seigler, J. T. Miller, C. Riggins, F. Axelrod & T. Clase 14506* (ILL); betw. Azara & Barahona, Feb. 1971, *F. Votava & A. H. Liogier 56X* (MO); Sierra Martín García, W of Barrera, 150–200 m, 14 Nov. 1984, *T. Zanoni, M. Mejía, J. Pimentel & R. García 32194*

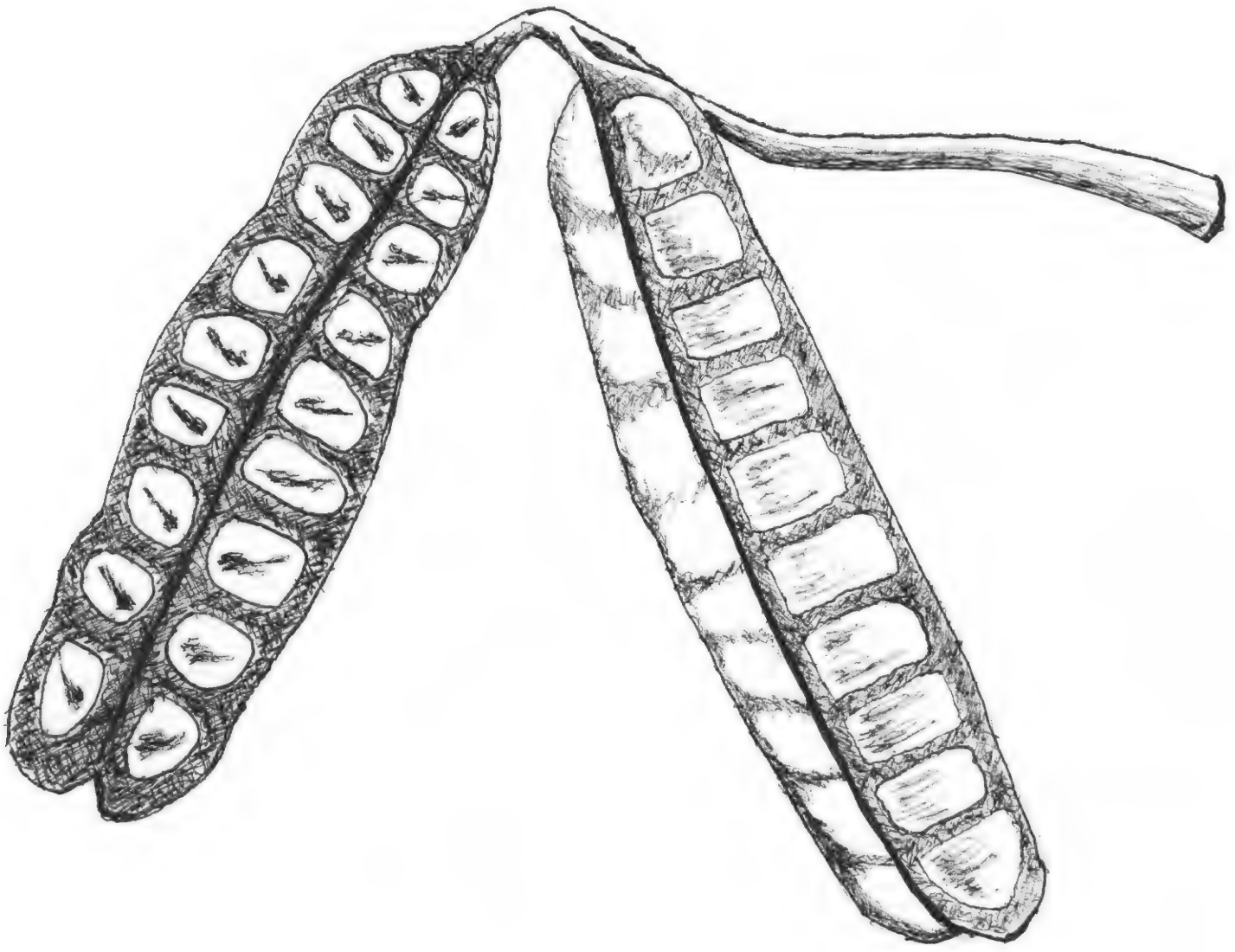

Figure 7. *Parasenegalia skleroxyla* (Tussac) Seigler & Ebinger. Fruits, tardily dehiscent. From an image provided by J. T. Miller.

(FTG). **Barahona:** Apr. 1910, *M. Fuertes 187* (F, HBG, MO); Tubano, 19 Mar. 1922, *H. von Schrenk 20* (MO); 1 km up stream from mouth of Río Baoruco, 30 m, 20 May 1981, *T. Zanoni, M. Mejía & C. Ramírez 13481* (MO). **Distrito Nacional:** El Número, 150 m, 27 Apr. 1974, *A. H. Liogier & P. Liogier 21615* (F, MO, NY). **Independencia:** 4 km NW of La Descubierta, 1250 ft., 15 Oct. 1981, *M. Mejía & J. Pimentel B. 17267* (FTG, MO); 2 km S Duvergé on rd. to Puerto Escondido, 40 m, 17 Aug. 1983, *T. Zanoni & J. Pimentel 26472* (FTG, MO, NY); 4.7 km S Puerto Escondido, on the rd. to Caseta, 765 m, 20 Mar. 1985, *T. Zanoni, M. Mejía, J. Pimentel & R. García 34044* (MO); 4–5 km S Puerto Escondido, on rd. to Aceitillar, 700–800 m, 10 May 1985, *T. Zanoni, M. Mejía, J. Pimentel & R. García 34670* (MO). **La Altagracía:** en la entrada al pueblo de Bayahibe, 10–15 m, 12 June 1994, *R. García, F. Jiménez & A. Veloz 5594* (F); Bayahibe, 10–30 m, 15 May 1987, *T. Zanoni, J. Pimentel, R. García & J. Salazar 39331* (FLAS, MO). **La Romana:** Isla Catalina, 0–10 m, 18 Dec. 1987, *T. Zanoni, M. Mejía, R. García & B. Santana 37340* (NY). **Monte Cristi:** Durán, 390 m, 11 Aug. 1930, *E. J. Valeur 462* (F, MO, NY). **Pedernales:** Loma El Guano, 200 m, 12 Apr. 1985, *A. Gentry & M. Mejía 50757* (MO); 5 km NW of Oviedo on rte. 44, 29 May 2006, *D. S. Seigler, J. T. Miller, C. Riggins, F. Axelrod & T. Clase 14511* (ILL); 22 km E of Pedernales on rte. 44, 1 June 2006, *D. S. Seigler, J. T. Miller, C. Riggins, F. Axelrod & T. Clase 14514* (ILL); Cabo Rojo, 10 m, 28 July 1990, *S. A. Thompson, J. E. Rawlins & C. Young 7573* (CM); Cabo Rojo, Feb. 1971, *F. Votava & A. H. Liogier 57X* (MO); un poco al S del puerto de Cabo Rojo, 25 m, 18 Sep. 1981, *T. Zanoni & M. Mejía 16755* (MO); Loma El Guano, 200 m, 25 July 1983, *T. Zanoni & J. Pimentel 26344* (FTG, MO); Los Quemados de Basilio, 200 m, 17 Oct. 1989, *T. Zanoni, J. Pimentel & A. Cabral 43658* (MO). **Peravia:** Las Calderas, en Las Dunas, 0–5 m, 8 Feb. 1987, *R. García, J. Pimentel & E. García 1929* (MO); San José de Ocoa, El Manaclar, 700 m, 13 July 1978, *M. Mejía 347* (MO); Cabeza de Toro, 9 km N of Baní, 800 ft., 6 May 1981, *M. Mejía, C. Ramírez & S. Peláez 13254* (F, FTG, MO). **Santiago:** El Castillo, Rincón Largo, 200 m, 28 July 1968, *J. J. Jiménez 5515* (NY); en la orilla del Río Guanajuma, 225 m, 24 Apr. 1991, *T. Zanoni & J. Hager 45102* (MO). **San Juan:** Candelón, 1938, *J. G. Scarff 4* (F); López, Candelón, 8 May 1887, *von Eggers 1832* (BM, HBG). HAITI. **Artibonite:** vic. of Gros Morne, 235 m, 19 Feb. 1926, *E. C. Leonard 10002* (CM). **Nord-Ouest:** Port-de-Paix, 29 June 1925, *E. L. Ekman 4432* (F, MO); Mole Rd., vic. of Jean-Rabel, 27 Jan.–9 Feb. 1929, *E. C. Leonard & G. M. Leonard 12617* (MO); 10 km E of Baie de Henne, 40 m, 10 June 1985, *T. Zanoni, M. Mejía & R. García 35085* (NY). **Ouest:** hills N of Glore, 600 m, 22 July 1924, *E. L. Ekman 1057* (DAV, MO); Ile La Gonave, Pointe-à-Raguettes, 10 Aug. 1927, *E. L. Ekman 8867* (DAV); Gonave Island, near Saline Madame

Doisy Pointe-à-Raquette, 10 Aug. 1927, *J. Eyerdam 144* (F). **Sud-Est:** vic. of La Vallée, Tortue Island, 28 Dec. 1928–9 Jan. 1929, *E. C. Leonard & G. N. Leonard 11281* (NY).

6. Parasenegalia visco (Lorentz ex Griseb.) Seigler & Ebinger, comb. nov. Basionym: *Acacia visco* Lorentz ex Griseb., Abh. Königl. Ges. Wiss. Göttingen. 19: 135, 279. 1874. [Pl. Lorentz. 87. 1874.] *Senegalia visco* (Lorentz ex Griseb.) Seigler & Ebinger in Seigler et al., Phytologia 88(1): 78. 2006. TYPE: Argentina. Catamarca: Fuerte de Andalgalá ad rivulos, 13 Jan. 1872, *P. G. Lorentz 340* (lectotype, designated here, GOET [image!] [11463]; isolectotypes, CORD [image!] [barcode] CORD00004860, SI [image!] [bc] SI001494). Figure 8.

Acacia concinna Phil., Anales Univ. Chile 2: 170. 1870, nom. illeg., non *Acacia concinna* (Willd.) DC., Prodr. [A. P. de Candolle] 2: 464. 1825. TYPE: Argentina. Mendoza: in hortis, *Philippi s.n.* (lectotype, designated here, SGO [image seen] [barcode] SGO000002427, SGO photo at SI; isolectotypes, SGO fragm. at SI, SI photo at F! [27897], G, MO).

Acacia platensis Manganaro, Anales Soc. Ci. Argent. 87: 128–133, figs. 12, 13. 1919. *Manganaroa platensis* (Manganaro) Speg., Bol. Acad. Nac. Ci. 26: 254, pls. 255, 257, 265. 1921. TYPE: Argentina (lectotype, designated by Cialdella, 1984: 96, LP [barcode] LPS24314).

Acacia polyphylla Clos in Gay, Fl. Chil. 2: 254. 1846, nom. illeg., non *Acacia polyphylla* DC., Cat. Pl. Horti Monsp., 74. 1813. *Lysiloma polyphyllum* Benth., Trans. Linn. Soc. London 30: 535. 1875. TYPE: Chile. "Pcia. Coquimbo, San Isidro, 1836, an culta" (lectotype, designated here, SGO [image seen]; isolectotypes, BR! [barcode] BR0000005117031, K [image seen] [bc] K000530853, P [image seen] [bc] P02142747. P [image seen] [bc] P03641821, P [image seen] [bc] P03641822, P [image seen] [bc] P03641823, P [image seen] [bc] P03641824, SGO fragm. at SI [image seen] [bc] SI661495).

Acacia riparia Kunth β [var.] *angustifoliola* Kuntze, Revis. Gen. Pl. 3(3): 47. 1898. TYPE: Bolivia. Santa Cruz: Sierra de Santa Cruz, 2000 m, *C. E. O. Kuntze s.n.* (lectotype, designated here, NY! [barcode] NY00001542; isolectotype, F!).

Manganaroa subsericea Speg., Bol. Acad. Nac. Ci. 26: 267. 1921 [1923]. TYPE: Argentina. Salta: "In dumetis montanis praeandinis, locis Quebrada de Guachipas et Pampa grande vocatis," *C. L. Spegazzini s.n.* (lectotype, designated by Seigler et al., 2006a: 78, LP (LPS-14305) [image seen] [barcode] LP001053; isolectotype, LP [bc] LP001054).

Tree to 25 m tall; bark not seen; twigs light to dark reddish brown, not flexuous, terete, glabrous to lightly puberulent; short shoots absent; prickles absent. Leaves alternate, 60–170 mm long; stipules light to dark brown, linear, symmetrical, flattened, straight, herbaceous, 2–6 mm long, 0.4–0.7 mm wide near the base, usually glabrous, tardily deciduous; petiole adaxially grooved, 25–45 mm long, lightly puberulent; petiolar gland solitary, anywhere along the petiole, sessile, usually oblong, 0.7–2.7 mm long, apex flattened to depressed, glabrous; rachis adaxially grooved, 35–130 mm long, puberulent, an oval to orbicular gland 0.5–1.2 mm across between the uppermost 1 to 2 pinna pairs, apex flattened to depressed, glabrous; pinnae (3)4 to 11(14) pairs/leaf, 40–70 mm long, 8–21 mm between pinna pairs; paraphyllidia 0.5–1.2 mm long; petiolule 1.1–2.2 mm long; leaflets 25 to 50 pairs/pinna, opposite, 0.8–2.1 mm between leaflet pairs, oblong, 3–7 × 0.8–2.1 mm, appressed pubescent on both surfaces, lateral veins sometimes obvious, 1 to 3 veins from the base, base oblique, truncate on one side, margins lightly ciliate, apex narrowly acute to acuminate, midvein submarginal, bluish purple beneath. Inflorescence a densely 40- to 75-flowered globose head 16–23 mm across, 1 to 3 in the leaf axils; peduncles 15–40 × 0.5–0.8 mm, puberulent; receptacle enlarged, not elongate, globose; involucre a small bract scattered along the peduncle, early deciduous, sometimes absent; floral bracts spatulate, 1.2–1.9 mm long, puberulent, early deciduous. Flowers sessile, white; calyx 5-lobed, 1.7–2.8 mm long, puberulent; corolla 5-lobed, 3.2–4.3 mm long, lightly puberulent, lobes 1/5 the length of the corolla; stamens 60 to 90; stamen filaments 8–11 mm long, distinct; anther glands present; ovary glabrous to rarely pubescent, stipe to 1 mm long. Legumes straight, flattened, not constricted between the seeds, oblong, 80–150 × 18–30 mm, chartaceous, transversely striate, glabrous to lightly puberulent, minute purple glands commonly present, dehiscent along both sutures; stipe 4–10 mm long; apex obtuse, the beak to 10 mm long; seeds uniseriate, no pulp, light brown, oval to oblong, strongly flattened, 9–13 × 7–10 mm, smooth; pleurogram U-shaped, 1.2–2.2 mm across.

Habitat and distribution. *Parasenegalia visco* has been collected from seasonally wet mountains, deciduous forests, riparian forests, yungas, disturbed second-growth forests, and thickets, from 750 to 3000 m in northern Argentina, through Bolivia, northern Chile, and Peru. The taxon is commonly cultivated in Peru as well as where native (Rico Arce, 2007).

Phenology. *Parasenegalia visco* flowers from October through January.

Local names and uses. Local names include visco, arca, viscote, viscote negro, viscote blanco, and visite (Rico Arce, 2007). *Parasenegalia visco* is commonly cultivated for its wood.

IUCN Red List category. *Parasenegalia visco* is assessed as Data Deficient (DD) at this time

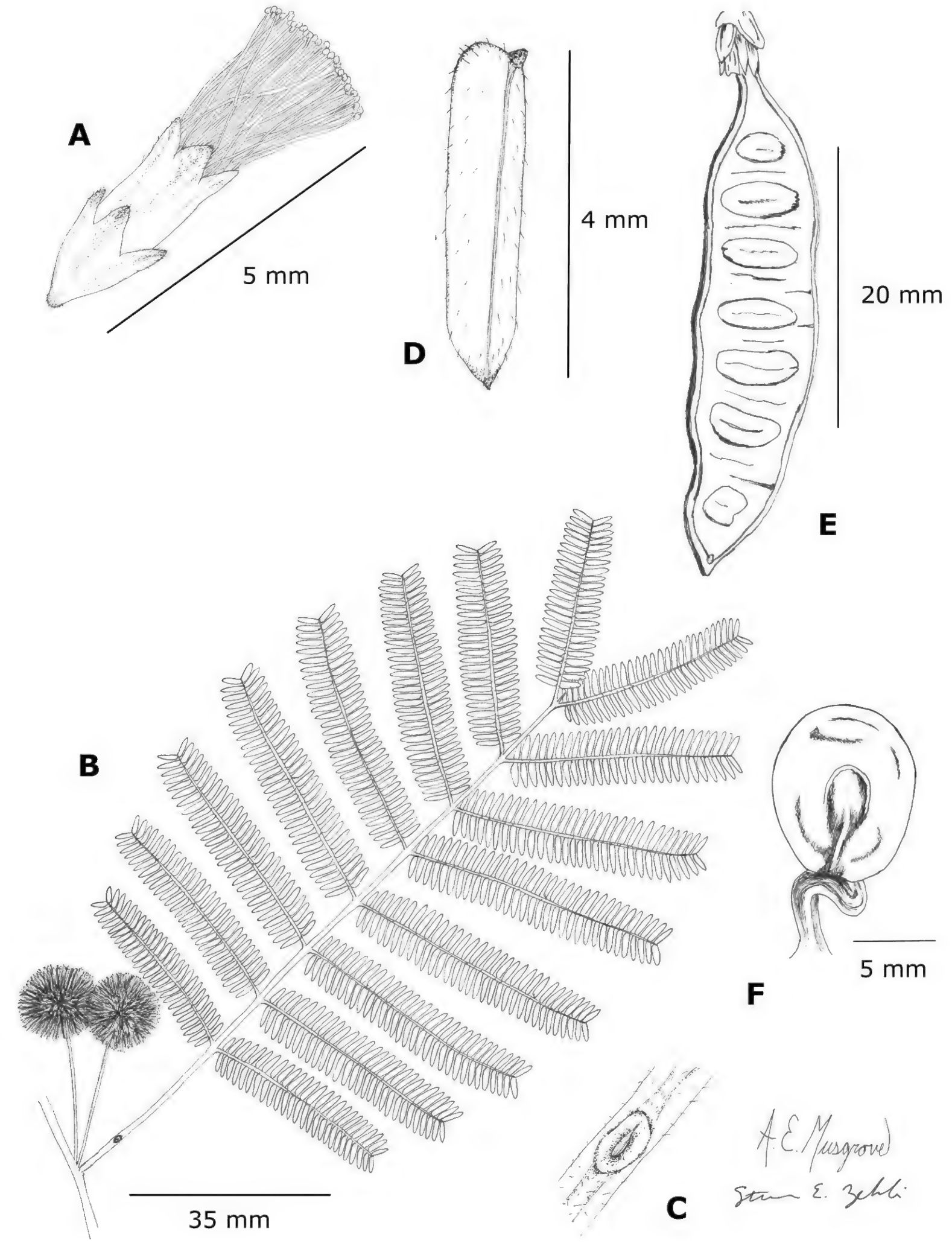

Figure 8. *Parasenegalia visco* (Lorentz ex Griseb.) Seigler & Ebinger. —A. Flower. —B. Twig with leaf and axillary inflorescences. —C. Petiolar gland. —D. Leaflet, abaxial view. —E. Fruit. —F. Seed. A–D from *Renvoize, Wilmot-Dear & Kiesling 3364* (MO); E from *Tillett 6611-57* (A); F from *Saldias & Pennington 1479* (MO).

(IUCN, 2001) but is an abundant species of southern South America and is commonly cultivated in Argentina, Chile, Peru, Uruguay, and South Africa as an ornamental and as a fast-growing tree for cabinet wood (Rico Arce, 2007). *Parasenegalia visco* is also known from numerous collections from Argentina and Bolivia and is probably of Least Concern (LC).

Discussion. *Parasenegalia visco* is a large South American tree that is commonly cultivated and economically important for wood products. The globose inflorescence more than 16 mm across, along with the small leaflets (3–7 × 0.8–2.1 mm) with bluish purple midveins, distinguish this species from other members of the genus.

Paul G. Lorentz was a German botanist and professor at the University of Córdoba, Argentina, until 1874. His vascular plant collections at GOET were the sources for species described by Grisebach in his *Plantae Lorentzianae* (1874) and *Symbolae ad Floram Argentinam* (1879). The collection *Lorentz 340* at GOET has an original label identifying the species as *Acacia visite*, which corresponded to the first name used by Grisebach in *Plantae Lorentzianae* (1874: 135), which was emended in this same work to *Acacia visco* (1874: 279). Although no collection was specified in the protologue, Lorentz can be assumed to be the collector (Stafleu & Cowan, 1976: 1011, 1981: 157) for species similarly described by Grisebach. The lectotype at GOET (11463) bears an original label with the spelling as *Acacia Visite*. This species was cited as introduced into South Africa as *Acacia visite* Griseb. (Ross, 1975).

Two common names were mentioned in the protologue by Grisebach (1874) for his *Acacia* species number 269 (1874: 135), as "[n]omen vernac. Visite, Visco." These vernacular names were a source of confusion for the species epithet. On page 135, Grisebach described the new species as "269. *Acacia Visite* Gr.," but this was emended by him in the same work on page 279 under "Verbesserungen" (Improvements), as "S. 135 nr. 269 statt [instead of] *A. Visite* Gr. lies [read] *A. Visco* Lor. in litt." It is this emendation that indicated Grisebach's intent to change the epithet to the other vernacular name, acknowledging Lorentz as well. Grisebach's intent was further supported in his later treatment of *Acacia* in *Symbolae ad Floram Argentinam* (1879: 122), where the species was also cited as "*A. Visco* Lor. mscr. – Syn. *A. Visite* Pl. Lor. [269]," with the number corresponding to the species number in the previous 1874 treatment in his *Plantae Lorentzianae*.

The specimen chosen as the lectotype of *Acacia concinna* is representative of that species and is from the home institution (SGO) of Philippi, the describing author.

No specimen was cited by Manganaro (1919: 128–129) in the protologue for *Acacia platensis*, although she did note the species as "visto cultivada esta planta en Buenos Aires y en La Plata. . .." Spegazzini (1921) transferred the name to the genus *Manganaroa* Speg. based on Manganaro's study. Cialdella cited the specimen with the word "typus" written on it, presumably used by both previous investigators, LP [barcode] LPS24314, as the holotype. We interpret this as a de facto lectotypification.

Although the name *Mimosa polyphylla* Clos was written on the type specimen of *Acacia polyphylla* Clos in Gay, apparently this name in *Mimosa* was never published. If this name were published, it would be the oldest name for *Parasenegalia visco*, but still illegitimate. The SGO lectotype chosen for *A. polyphylla* is representative of the species and is from the home institution of the describing author.

Kuntze (1898: 47) described *Acacia riparia* var. *angustifoliola* from two countries as "Bolivia: Sierra de Santa Cruz 2000 m. and Argentina: Provinz Santiago." Of these two possible syntypes, the NY (barcode NY00001542) sheet from Bolivia was annotated by Seigler and Ebinger (2009) as the holotype, emended here as the lectotype.

A syntype of *Manganaroa subsericea* from Argentina (prov. Buenos Aires, La Plata, Jardín Botánico "Facultad de Agron."), also identified as the collection *C. L. Spegazzini s.n.*, is at LP (LPS-14305) (Cialdella, 1984).

Specimens examined. ARGENTINA. **Catamarca:** Andalgalá, 1950 m, 28 Nov. 1946, *C. A. O'Donnell 4183* (S); S of Cumbre de las Lajos, 1700 m, 26 Nov. 1946, *B. Sparre 976* (S); Choya–El Tofo, 1800 m, 28 Nov. 1946, *B. Sparre 1003* (S); Andalgalá, 28 Nov. 1946, *E. Wall s.n.* (MO). **Córdoba:** 4 km N of Sarmiento, 1080 m, 12 Oct. 1988, *J. Aronson 7646* (MO); Puesto del Paraiso, 4 Jan. 1897, *T. Stuckert 1271* (G); Villa Rosario, 14 Nov. 1902, *T. Stuckert 11963* (G). **Jujuy:** El Volcán, 13 May 1873, *Lorentz & Hieronymus 714* (S), *759* (S); Purmamarca, 11 Jan. 1971, *A. Krapovickas & C. L. Cristóbal 17637* (WIS); 2 km de Volcán camino a Lozano, 2340 m, 10 Feb. 1998, *O. Morrone, N. B. Deginani, A. M. Cialdella & L. M. Giussani 2401* (MO); Sierra de Calidegus, 800 m, 15 Oct. 1927, *S. Venturi 5382* (CAS, GH, MO); San Pedro, 750 m, 20 Oct. 1929, *S. Venturi 9744* (CAS, MO); Purmamarca, 28 Oct. 1982, *E. M. Zardini & M. L. Pochettino 1564* (MO). **La Rioja:** 10 km S of Famatina, RN 40, 1450 m, 14 Mar. 1993, *S. M. Botta & D. C. Miconi 590* (MO); Famatina, 1600 m, 11 Jan. 1947, *J. H. Hunziker 1815* (MO); Castro Barros, 15 km W of Anillaco, 1980 m, 30 Mar. 1992, *J. H. Hunziker & J. C. Gamerro 12480* (MO); Los Duraznillas, 750 m, 3 Nov. 1947, *I. Huasi 35* (GH). **Salta:** 20 km S of Salta, 1120 m, 5 Nov. 1988, *J. Aronson 7690* (MO); Cafayate, 8 Nov. 1978, *A. L. Cabrera, S. Botto, C. Ezcurra, A. M. Ragonese & M. Vázques A. 29703* (MO); Cafayate, 8 Jan. 1972, *A. Krapovickas & C. L. Cristóbal 20727* (WIS); Chorrillos, 2110 m, 17 Jan. 1941, *T. Meyer 3560* (GH); San Fernando, 6 May 1947, *T. Meyer 12457* (RSA, US); Iruya, 2700–2800 m, 8 Nov. 1988, *L. J. Novara, T. Adzet & J. Masso 8198* (B, M); Salta, 5 Nov. 1982, *E. M. Zardini 1619* (MO); Iruya, 10 Feb. 1983, *E. M. Zardini 1965* (GH); Iruya, 10 Feb. 1983, *E. M. Zardini, M. L. Pochettino, J. Hurrell, C. Iudica & D. Ramadori 1965*

(MO). **Tucumán:** San Javier, 1050 m, 4 Nov. 1978, *S. A. Renvoize, M. Wilmot-Dear & R. Kiesling 3364* (MO); Francas a Zárate, 780 m, 12 Oct. 1925, *Schreiter 68590* (BM); Tapia, 27 Oct. 1976, *D. S. Seigler & F. Vervoorst 10108A* (EIU, ILL); Tapia, 27 Oct. 1976, *D. S. Seigler & F. Vervoorst 10114* (ILL, MO); 13.8 km SE of Amaichá del Valle on rd. to Tafi del Valle, 2400 m, 4 May 1985, *J. C. Solomon 13536* (MO); Yerba Buena, 700 m, 1926, *S. Venturi 67* (GH); Tapia, 750 m, 24 Oct. 1923, *S. Venturi 2476* (CAS, MO); Cerro del Campo, 800 m, 4 Nov. 1928, *S. Venturi 7452* (GH). BOLIVIA. **Chuquisaca:** Comunidad Pitatorillas, 2774 m, 22 Sep. 2007, *M. Jiménez, E. Cervantes & F. Janko 361* (ILL, MO). **Cochabamba:** camino hacia Omereque, Km. 186, 2040 m, 27 Oct. 1993, *C. Antezana 397* (MO); vic. of Cochabamba, 1891, *M. Bang 921* (MO); city of Cochabamba, 18 Nov. 1982, *L. Bohs 1990* (F, GH); near Arani, 2770 m, May 1947, *M. Cárdenas & H. C. Cutler 3883* (GH); Arani, 2700 m, 29 Nov. 1979, *T. Feuerer 6942* (HBG); park, Colina de San Sebastian, Cochabamba, 2575 m, 24 Nov. 1984, *M. Nee 30352* (MO); 6 km NE of El Convento, 2546 m, 13 Mar. 2003, *L. Rico 1559* (MO); Mizque, 2025 m, 27 Dec. 2002, *L. Rico & T. Windsor-Shaw 1199* (MO); Carrasco, 2100 m, 11 Feb. 1987, *J. C. Solomon & M. Nee 16024* (ILL, MO, NY). **La Paz:** Hacienda Huajchilla, 18 km SE of La Paz, 3000 m, 18 Dec. 1986, *J. C. Solomon 15777* (ILL, MO). **Potosí:** Charcas, 2500 m, *A. Uzedo 5* (HBG). **Santa Cruz:** Saipina, 1800 m, 22 Oct. 1994, *J. Balcazar 69* (MO); hills E of Salta, 1300–1400 m, 22 Sep. 1985, *A. Gentry & C. Palacia 51731A* (MO); rd. from Mairana to Postrervalle, 7.7 km SSE of Quirusillas, 1750 m, 31 Dec. 1997, *M. Nee 47660* (ILL, MO); 3.7 km NW of bridge over Rio Comarapa at Comarapa, 2000 m, 24 Nov. 1999, *M. Nee 50593* (MO); 5 km SW of Comarapa on rd. to Chilón, 1775 m, 26 Nov. 1999, *M. Nee 50668* (MO); 40 km E of Comarapa, 1740 m, 22 Oct. 1991, *M. Saldias & T. Pennington 1479* (MO); 11 km de Comarapa, 2740 m, 3 July 1989, *D. N. Smith, V. García & M. Buddensiek 13607* (MO); Comarapa, 2000 m, 26 Oct. 1928, *J. Steinbach 8578* (A, GH, S); Huasacañada, 2050 m, 15 Feb. 1990, *I. G. Várgas C. 429* (MO); Huasacañada, 2050 m, 5 Nov. 1989, *I. G. Várgas C. 333* (MO); Huasacañada, 5 km S of Vallegrande, 2050 m, 3 Nov. 1990, *I. G. Várgas C. 804* (MO); Huasacañada, 5 km S of Vallegrande, 2050 m, 15 May 1992, *I. G. Várgas C. 1398* (MO); Vallegrande, 13 km pasando Pucara en el camino hacia el Puente del Río Grande, 1150 m, 21 Oct. 2001, *I. G. Várgas, C. Jordan & A. Várgas J. 6622* (ILL, MO). **Tarija:** 6 km SW of Chocloca, 2000 m, 25 Mar. 1979, *St. G. Beck 751* (US); Tarija, 1920 m, 10 Jan. 1979, *C. Ruiz s.n.* (US); 30 km de Tarija (vers Entre Rios), 1850 m, 3 Dec. 1975, *J. R. de Sloover 381* (MO). CHILE. **Tarapacá:** Arica Prov., 1st Region, Codpa, 1820 m, 12 Feb. 1989, *J. Aronson 7758* (MO). PERU. **Lima:** Lima, 28 Nov. 1966, *S. S. Tillett 6611-57* (A) (cultivated). **Tacna:** Alrededores de Tacna, 30 Oct. 1948, *R. Ferreyra 4071* (MO, US).

7. **Parasenegalia vogeliana** (Steud.) Seigler & Ebinger, comb. nov. Basionym: *Acacia vogeliana* Steud., Nomencl. Bot., ed. 2, 1: 9. 1841, replacement name for *Acacia ambigua* Vogel, Linnaea 10: 600–601. 1836, nom. illeg., non *Acacia ambigua* Hoffmanns., Verz. Pfl.-Kult. Nachtr. 3: 15. 1826. *Senegalia vogeliana* (Steud.) Britton & Rose, N. Amer. Fl. 23(2): 116. 1928. *Lysiloma ambiguum* Urb., Ark. Bot. 22A: 28. 1929, nom. illeg. *Lysiloma vogeliana* (Steud.) Stehlé, Bull. Mus. Natl. Hist. Nat., sér. 2, 18: 193. 1946. TYPE: Haiti. Santo Domingo, "Plaine prés de Port-au-Prince," 1839, *C. A. Ehrenberg 274* (lectotype, designated by Seigler et al. 2006: 79, HAL! [barcode] HAL0040798, HAL photo at K; isolectotypes, B†, NY! [bc] NY00001533, B photo at K, B fragm. at US! [bc] US000000564). Figure 9.

Large climbing shrub or tree to 10 m tall; bark gray to dark brown, smooth; twigs light reddish brown to light gray, not flexuous, terete, glabrous to puberulent; short shoots absent; prickles absent. Leaves alternate, 60–145 mm long; stipules light to dark brown, linear, symmetrical, flattened, straight, herbaceous, 2–6 mm long, 0.3–0.7 mm wide near the base, usually glabrous, tardily deciduous; petiole shallowly adaxially grooved, 18–42 mm long, lightly puberulent to glabrous; petiolar gland solitary, usually located just below the lowermost pinna pair, sessile, globose, 0.8–1.8 mm across, apex depressed, glabrous; rachis adaxially grooved, 30–90 mm long, usually puberulent, a globose gland 0.6–1.2 mm across between the uppermost 1 to 2 pinna pairs, apex depressed, glabrous; pinnae 3 to 6 (7) pairs/leaf, 45–95 mm long, 9–20 mm between pinna pairs; paraphyllidia 0.3–1.1 mm long; petiolule 3.5–7 mm long; leaflets 8 to 20 pairs/pinna, opposite, 4–8 mm between leaflet pairs, oblong, 8–18 × 3.1–8.1 mm, appressed pubescent beneath and sometimes above, lateral veins obvious, 3 to 5 veins from the base, base oblique and obtuse, margins not ciliate, apex obtuse to acute, midvein subcentral to submarginal. Inflorescence a densely 20- to 50-flowered globose head 9–14 mm across, in axillary and terminal pseudopaniculate clusters, the main axis to 350 mm long; peduncles 3–14 × 0.4–0.6 mm, densely pubescent; receptacle not enlarged, not elongated; involucre a single small bract on the peduncle, early deciduous; floral bracts spatulate, 0.4–0.9 mm long, puberulent, early deciduous. Flowers sessile, white; calyx 5-lobed, 1.2–1.8 mm long, puberulent; corolla 5-lobed, 2.1–3.1 mm long, puberulent, lobes nearly 1/2 the length of the corolla; stamens 40 to 80; stamen filaments 4.5–6.3 mm long, distinct; anther glands present; ovary glabrous, stipe to 1.6 mm long. Legumes straight, flattened, not constricted between the seeds, oblong, 60–170 × 25–32 mm, chartaceous, transversely striate, glabrous, eglandular, dehiscent along both sutures; stipe 10–30 mm long; apex

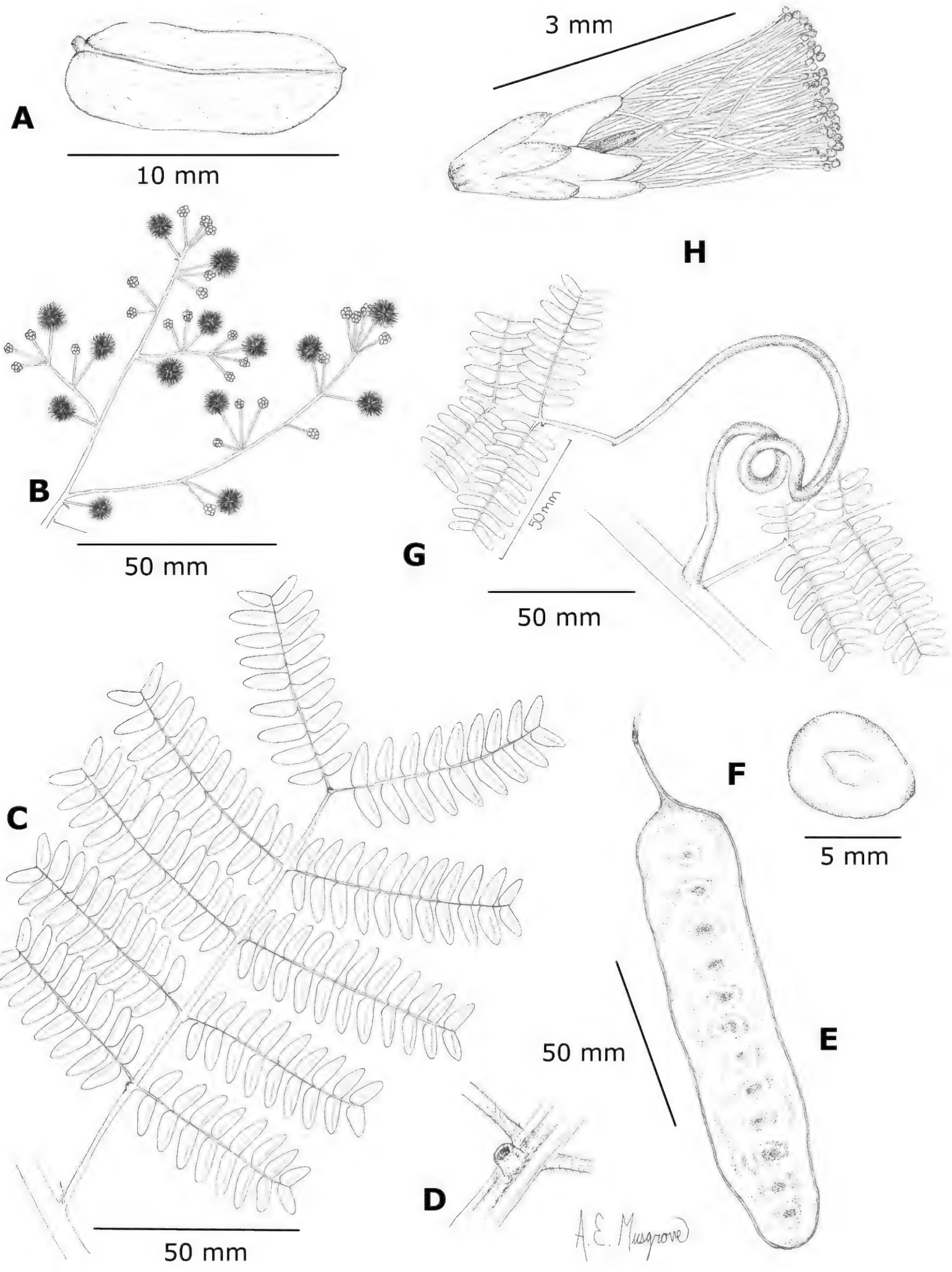

Figure 9. *Parasenegalia vogeliana* (Steud.) Seigler & Ebinger. —A. Leaflet, abaxial surface. —B. Portion of pseudopaniculate cluster. —C. Leaf, adaxial surface. —D. Petiolar nectary. —E. Fruit. —F. Seed. —G. Modified coiled branch. —H. Flower. A, C, D from *García, Jiménez, Caminero & Hoener 4834* (MO); B, H from *Ekman 6620* (NY); E–G from *Acevedo Rodríguez & Siaca 3794* (MO).

obtuse, usually not beaked; seeds uniseriate, no pulp, light to dark brown, nearly oval, strongly flattened, 6.5–8.4 × 6–7.5 mm, smooth; pleurogram U-shaped, 2–3 mm across.

Habitat and distribution. *Parasenegalia vogeliana* is known from dry deciduous tropical forests, dry scrub, disturbed second-growth forest, and thickets from sea level to 500 m in the Caribbean.

Phenology. *Parasenegalia vogeliana* flowers from June through September.

Local names. Local names include cha cha venenosa, macata bourse bastard, mata puerco, taquito, and tchia-tchia marrón (Rico Arce, 2007).

IUCN Red List category. *Parasenegalia vogeliana* is assessed as Data Deficient (DD) at this time (IUCN, 2001). This species is relatively common in Hispaniola but is uncommon in Puerto Rico. It has been collected in the Virgin Islands and Lesser Antilles. Because of restricted habitat the species is probably Vulnerable (VU) other than in Hispaniola.

Discussion. The name *Acacia vogeliana* Steud. (1841) was a replacement for the illegitimate *A. ambigua* Vogel (1836). Vogel's protologue (1836: 601) mentioned branches sent by Ehrenberg, "[r]amuli partem cl. Ehrenberg misit tantum summam. . .." The collection was incorporated from the Herbarium of Carl Daniel Friedrich Meisner at NY. There are a B fragment and photo of a specimen of *Ehrenberg s.n.* (s.d.) with "Com. . .. Schlechtendahl 1829" on the label on a US specimen, and both most probably represent type materials. Based on information on specimens, the original collection appears to be from Haiti, Santo Domingo. A HAL specimen (*C. A. Ehrenberg 274*) is fruiting and in excellent condition, and is thus chosen for the lectotype.

Parasenegalia vogeliana is the only Caribbean member of the genus with globose inflorescences, the other species (*P. muricata* and *P. skleroxyla*) being spicate. Using vegetative material, *P. vogeliana* and *P. muricata* are somewhat similar, particularly the size of the leaves and leaflets. *Parasenegalia muricata* has tough, leathery leaflets that have slightly revolute margins, the leaflets of *P. vogeliana,* in contrast, being thinner and lacking revolute margins. In addition to the counties and islands listed above, Rico Arce (2007) listed this species for Guadeloupe. We have seen no specimens from that location.

Specimens examined. DOMINICAN REPUBLIC. **Barahona:** Las Salinas, 500 m, July 1911, *M. Fuertes 985* (NY); La Hoya, Mata Yaya, rd. from Las Matas to Bánica, 400 m, 10 Sep. 1968, *A. H. Liogier 12646* (NY); 7 km de Cabral a Polo, 13 Oct. 1981, *M. Mejía & J. Pimentel 17183* (JBSD, MO, NY). **La Romana:** half-way betw. Presa Chavón & Bayahibe on Las Romana–Bayahibe rd., 40–60 m, 10 Nov. 1980, *M. Mejía & T. Zanoni 9082* (MO, NY); Altos de Chavón, ENE of La Romana, 75–100 ft., 13 June 1981, *T. Zanoni, M. Mejía & C. Ramírez 14836* (JBSD, MO, NY). **Pedernales:** 5 km al W de Oviedo, 50 m, 20 June 1977, *Bro. Alain & P. Liogier 26716* (NY); en la región de Banano, 500 m, 25 June 1977, *Bro. Alain & P. Liogier 26962* (NY); Sierra de Bahoruco, 19 km al NO del poblado Higüero, 450 m, 8 June 1995, *R. García, F. Jiménez, G. Caminero & D. Hoener 4834* (MO); 3 km al W de Manuel Goya, 30 Sep. 1995, *R. García, M. Mejía, E. Jiménez, S. Rodríguez & A. Veloz 5921* (F, MO); Las Mercedes, 400 m, 22 Feb. 1969, *A. H. Liogier 14117* (NY); betw. Cabo Rojo & Las Mercedes, 100 m, 3–8 July 1971, *A. H. Liogier 18120* (NY); 3 km N of Pedernales, 1 June 2006, *D. S. Seigler, J. T. Miller, C. Riggins, F. Axelrod & T. Clase 14524* (ILL); 6 km N of Pedernales, 1 June 2006, *D. S. Seigler, J. T. Miller, C. Riggins, F. Axelrod & T. Clase 14525* (ILL); 12 km N of Pedernales, 1 June 2006, *D. S. Seigler, J. T. Miller, C. Riggins, F. Axelrod & T. Clase 14526* (ILL); 5 km NW of Oviedo on rte. 44, 29 May 2006, *D. S. Seigler, J. T. Miller, C. Riggins, F. Axelrod & T. Clase 14510* (ILL), *14510A* (ILL); Llanuras Costeras, 8–10 m, 25 July 1982, *T. Zanoni & G. R. Proctor 22027* (JBSD). HAITI. **Artibonite:** Gonaives to La Brande, 500 ft., 14 Aug. 1905, *G. V. Nash & N. Taylor 1619* (NY). **Ouest:** Port-au-Prince, 26 Sep. 1924, *E. L. Ekman 2024* (MO); 300 m, *E. L. Ekman 4642* (IJ); Port-au-Prince, 100 m, 11 Aug. 1926, *E. L. Ekman 6620* (F, NY). LESSER ANTILLES. **Martinique:** Macata house, 120 m, 4 Feb. 1940, *M. Stehlé & H. Stehlé 4837* (US). PUERTO RICO. N of Parguera on rte. 304, 27 May 2006, *D. S. Seigler, J. T. Miller, C. Riggins & D. Kolterman 14493* (EIU, ILL); 2.3 mi. N of La Parguera on rte. 304, 27 May 2006, *D. S. Seigler, J. T. Miller, C. Riggins & D. Kolterman 14501* (EIU, ILL). VIRGIN ISLANDS. **St. John:** Reef Bay Quarter, along Bordeaux Rd., 6 Jan. 1991, *P. Acevedo Rodríguez & A. Siaca 3794* (F, MO, NY).

II. Pseudosenegalia Seigler & Ebinger, gen. nov. TYPE: *Acacia feddeana* Harms, Repert. Spec. Nov. Regni Veg. 16: 450. 1920 [≡ *Pseudosenegalia feddeana* (Harms) Seigler & Ebinger].

Shrubs or small trees, some to 12 m; twigs terete or nearly so, not flexuous; short shoots present; prickles and stipular spines absent. Leaves alternate or clustered on short shoots, bipinnate; stipules small, linear, symmetrical, herbaceous, tardily deciduous to persistent; petioles adaxially grooved, 0.5–13 mm long; petiolar gland usually present, sessile, solitary; rachis adaxially grooved, usually with glands between some pairs of pinnae; pinnae 1 to 7 pairs/leaf, opposite; paraphyllidia absent; leaflets 11 to 26 pairs/pinna, linear, 1.2–2.9 × 0.4–0.9 mm, 1 vein from the base, glabrous to lightly pubescent, midrib subcentral. Inflorescences a cylindrical spike, 1 to 2 clustered in leaf axils. Flowers bracteate, sessile, actinomorphic, sympetalous, 5-merous, with a basal copular nectiferous disk; stamens 100 to 150, distinct, attached along the side of the nectariferous disk, exserted; anthers small, dorsifixed, dehiscing vertically, anther glands absent; ovary with a stipe to 2.1 mm long; style filiform; stigma filiform. Legumes straight to slightly curved, flattened to elliptic in cross section, oblong, eglandular, dehiscing along

both sutures; seeds uniseriate, not surrounded by pulp, ovoid to ellipsoid, flattened; pleurogram present or absent.

Habitat and distribution. *Pseudosenegalia* is known to occur in dry scrub and thorn-scrub vegetation between 1300 and 3300 m in Bolivia.

Taxonomic Key to Species of *Pseudosenegalia*

1. Leaves with a single pair of pinnae .... *P. feddeana* (Harms) Seigler & Ebinger
1′. Leaves with 3 to 7 pairs of pinnae ..... *P. riograndensis* (Atahuachi & L. Rico) Seigler & Ebinger

1. Pseudosenegalia feddeana (Harms) Seigler & Ebinger, comb. nov. Basionym: *Acacia feddeana* Harms, Repert. Spec. Nov. Regni Veg. 16: 450. 1920, replacement name for *Acacia fiebrigii* Harms, Repert. Spec. Nov. Regni Veg. 16: 351. 1920, nom. illeg., non *Acacia fiebrigii* Hassl., Repert. Spec. Nov. Regni Veg. 8: 553. 1910. *Acacia molfinoi* Speg., Bol. Acad. Nac. Ci. 26: 219. 1921, nom. illeg. superfl. *Senegalia feddeana* (Harms) Seigler & Ebinger in Seigler et al., Phytologia 88(1): 51. 2006. TYPE: Bolivia. S. Bolivien, Renecillo bei Tupiza, 2700–3000 m, 28 Feb. 1904, *K. Fiebrig 3113* (lectotype, designated here, B! [barcode] B100244206, B photos at F! F0BN001274; isolectotypes, B, B fragm. at F! [bc] FV0058010F, BM not seen [bc] BM000952369, G! [bc] G00307474, G [image seen] [bc] G00307475, G [image seen] [bc] G00367708, GH! [bc] GH00058288, LD [image seen] [bc] LD1220764, MO!, S! [bc] S-R-8512, SI not seen [bc] SI001474, US! [bc] US00000210]. Figure 10.

Shrub or small tree to 8 m tall; bark gray-white to white, smooth; twigs dark purple to dark reddish brown, not flexuous, terete, puberulent; short shoots present at older nodes, 0.5–2.5 mm long, covered with bud scales, stipule remnants, and old leaf bases; prickles absent. Leaves alternate, also clustered on short shoots, 0.5–5.3 mm long; stipules dark brown to black, linear, symmetrical, terete, straight to slightly curved, herbaceous, 0.8–3.5 mm long, 0.1–0.3 mm wide near the base, glabrous, persistent; petiole adaxially grooved, 0.5–5.3 mm long, lightly puberulent; petiolar gland solitary, located at the apex of the petiole between to just below the single pinna pair, sessile, orbicular, 0.2–0.8 mm across, apex globose, glabrous; rachis absent; pinnae 1 pair/leaf, 13–23 mm long; paraphyllidia absent; petiolule 0.8–1.5 mm long; leaflets 11 to 25 pairs/pinna, opposite, 0.3–0.6 mm between leaflet pairs, linear, 1.5–2.8 × 0.4–0.8 mm, lightly appressed pubescence beneath, lateral veins not obvious, 1 vein from the base, base oblique, truncate on one side, margins lightly ciliate, apex acuminate, midvein central to subcentral. Inflorescence a loosely 20- to 45-flowered cylindrical spike, 20–28 × 16–19 mm, 1 to 2 from leaf axils and short shoots; peduncles 2–6 × 0.7–0.9 mm, lightly puberulent; receptacle elongated, not enlarged; involucre absent; floral bracts linear, 0.7–1.2 mm long, ciliate, early deciduous. Flowers sessile, pale creamy white; calyx 5-lobed, 1.2–2.1 mm long, puberulent; corolla 5-lobed, 3.3–4.3 mm long, puberulent, lobes 1/4 the length of the corolla; stamens 100 to 140; stamen filaments 8–10 mm long, distinct; anther glands absent; ovary glabrous, stipe to 0.7 mm long. Legumes straight to slightly curved, elliptic in cross section, constricted between the seeds, oblong, 40–170 × 12–20 mm, coriaceous, reticulately striated, puberulent, eglandular, dehiscent along both sutures; stipe 2–9 mm long; apex acuminate, not beaked; seeds uniseriate, no pulp, dark brown, oval, flattened, slightly pitted, 14–19 × 10–16 mm; pleurogram absent.

Habitat and distribution. *Pseudosenegalia feddeana* is a species of dry scrub and thorn-scrub vegetation found between 2000 and 3300 m in southern Bolivia.

Phenology. *Pseudosenegalia feddeana* flowers from September through December.

IUCN Red List category. *Pseudosenegalia feddeana* is assessed as Data Deficient (DD) at this time (IUCN, 2001). However, the species is apparently relatively common in a restricted area of Bolivia, suggesting that the species is probably of Least Concern (LC).

Discussion. Harms (1920: 351) described *Acacia fiebrigii* from the single collection *Fiebrig 3113*, not specifying any herbarium of deposit. He quickly replaced the epithet (Harms, 1920: 450), which was superfluous against an earlier *A. fiebrigii* (Hassler, 1910). The current lectotypification of the replacement name *A. feddeana* clarifies the herbarium of deposit at B, at the principal institution of the describing author.

In the year following the publication of Harms's new name *Acacia feddeana*, Spegazzini (1921: 219) also published a replacement name for Harms's later homonym *A. fiebrigii*. This was included in discussion under Spegazzini's treatment of *A. recurva* Benth., and *A. molfinoi* was clearly associated with

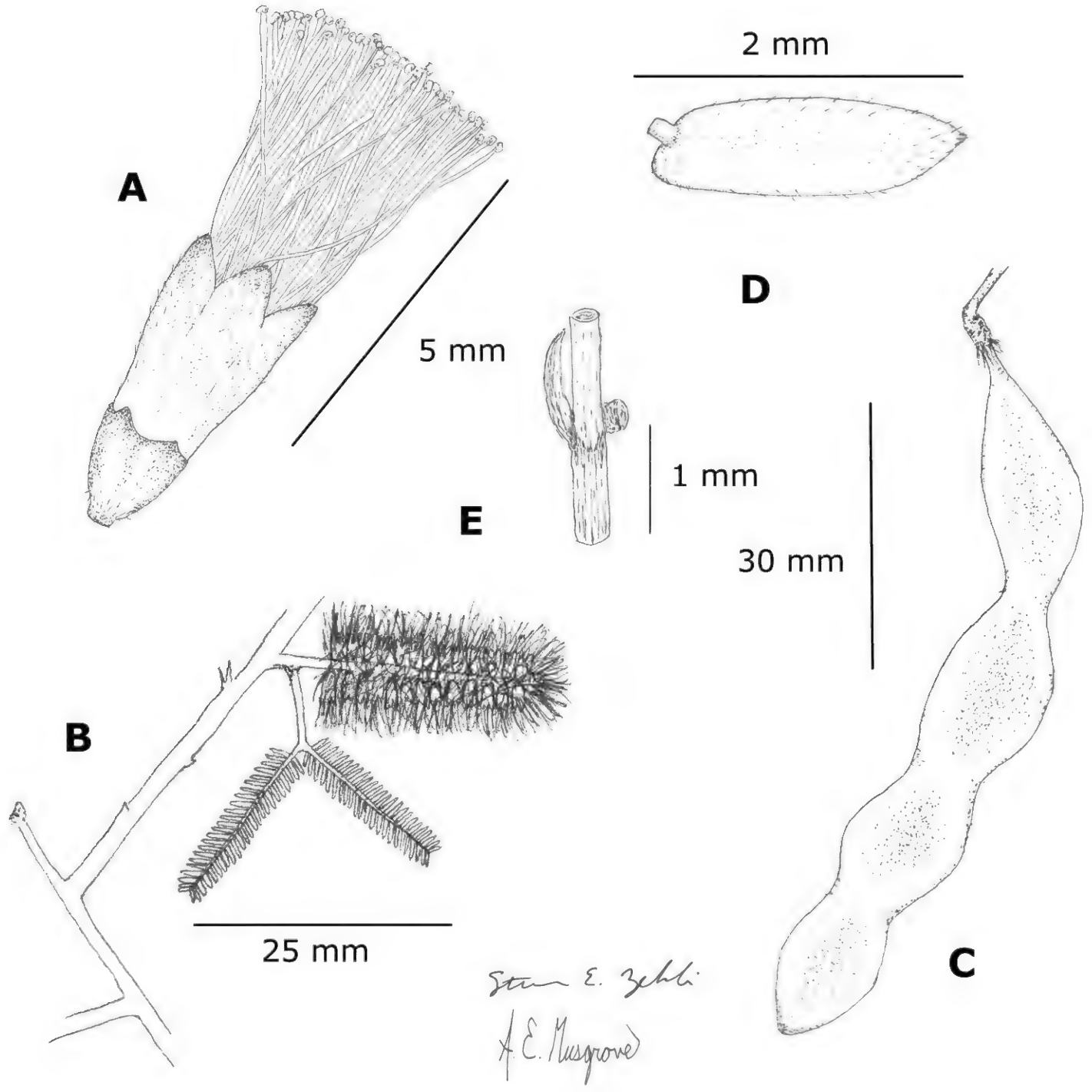

Figure 10. *Pseudosenegalia feddeana* (Harms) Seigler & Ebinger. —A. Flower. —B. Twig with leaf and spicate inflorescence. —C. Fruit. —D. Leaflet, adaxial surface. —E. Petiolar gland. A–E from *Vuilleumier 410* (NY).

A. fiebrigii as its replacement, which was unfortunately too late and therefore illegitimate and superfluous.

One pair of pinnae separates *Pseudosenegalia feddeana* from *P. riograndensis*.

Specimens examined. BOLIVIA. **s. loc.:** 1992, *G. Navarro Sánchez 1262* (MO). **Chuquisaca:** Nor Cinti Prov., 38 km S of Camargo on rd. from Potosí to Tarija, 2350 m, 26 Feb. 1989, *J. Aronson 7801* (MO); Trayecto Las Carreras–Camargo, 2261 m, 31 Dec. 2005, *M. Serrano, J. Villalobos, A. Lliully, J. A. Peñaranda & R. Lozano 7151* (ILL, MO, NY); Sud Cinti Prov., 2 km N of Impora along rd. from Tarija to Las Carreras, 2600 m, 5 Dec. 1967, *B. Vuilleumier 410* (GH, NY, TEX, US). **Potosí:** 3000 m, Dec. 1932, *M. Cárdenas 300* (US); Potosi, Calcha, 26 Oct. 1989, *S. Peca s.n.* (NY); Cantón Calcha, camino entre Pucapampa y Panica, 2800 m, 23 Sep. 1987, *M. Schulte 1* (NY); Cantón Yawisla, orilla del camino Mayopalca-Surmajchi, 2850 m, 4 Feb. 1988, *M. Schulte 123* (NY); Prov. Nor Chichas, colina con laderas, 3300 m, 15 Apr. 1993, *G. Torrico & C. Peca 393* (NY); Mar. 1979, *L. Verlinde s.n.* (BR). **Tarija:** Iscayachi 50 km hacia el valle de Paicho, 2700 m, 11 Nov. 1993, *G. Beck, R. Kiesling & D. Metzing 22103* (MO); Tojo, 12 Feb. 1960, *T. Meyer, R. Cuezzo & R. Legame 21617* (GH); Méndez, localidad de Paicho Norte, 2100 m, 19 Feb. 2007, *I. L. Foronda 975* (ILL. MO, NY); Tomayapo, Prov. Mendez, 2934 m, 19 Apr. 2003, *L. Rico, T. Windsor-Shaw & C. Vacaflores 1641* (MO, NY).

2. Pseudosenegalia riograndensis (Atahuachi & L. Rico) Seigler & Ebinger, comb nov. Basionym: *Acacia riograndensis* Atahuachi & L. Rico, Kew Bull. 62: 605. 2007. TYPE: Bolivia. Cochabamba: Prov. Campero, Pasorapa, en la bajada de Buenavista hacia el Río Grande, 1447 m, 27 Dec. 2004, *J. R. I. Wood, M. Atahuachi & M. Mercado 21251* (holotype, BOLV; isotypes, K! [barcode] K00503018, K! [bc] K005033019, LPB [bc] LPB0000676, MEXU [bc] MEXU0128851). Figure 11.

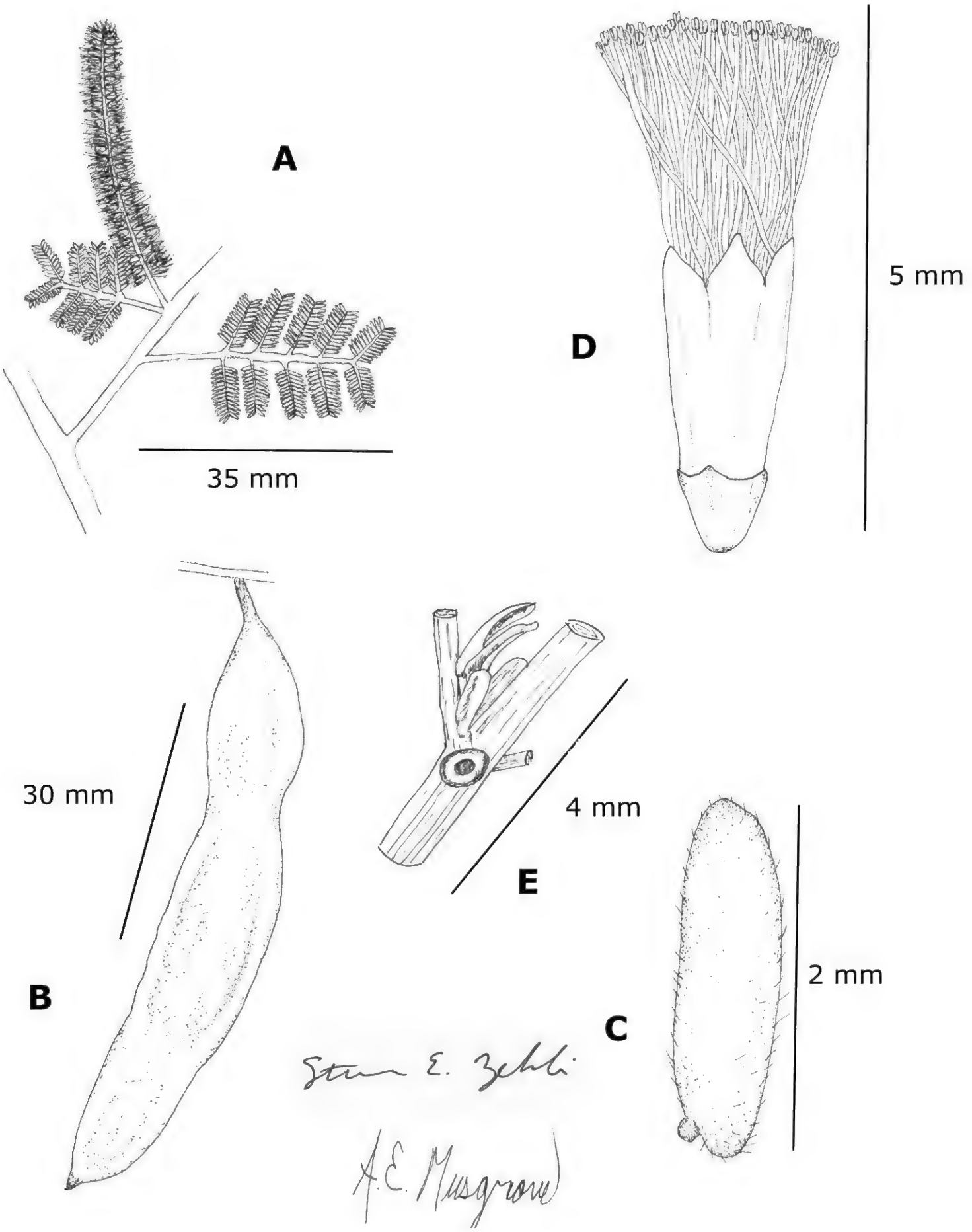

Figure 11. *Pseudosenegalia riograndensis* (Atahuachi & L. Rico) Seigler & Ebinger. —A. Twig with inflorescences and leaves. —B. Fruit. —C. Leaflet, adaxial surface. —D. Flower. —E. Petiolar gland. A–E from *Antezana 1325* (NY).

Tree to 12 m tall; bark nearly white, smooth to shallowly fissured; twigs orange to reddish brown, not flexuous, terete, glabrous; short shoots present at some nodes, 0.4–1 mm long, with a few leaves attached; prickles absent. Leaves alternate, also clustered at short shoots, 15–55 mm long; stipules light brown, linear, symmetrical, flattened, straight, herbaceous, 1–2.5 × 0.1–0.2 mm, glabrous, usually persistent; petiole adaxially grooved, 4–13 mm long, glabrous; petiolar gland solitary, located just below to nearly between the lowermost pinna pair, sessile; orbicular to oval, 0.4–1.1 mm across, apex depressed, glabrous, sometimes absent; rachis adaxially grooved, 5–40 mm long, glabrous, an orbicular gland 0.3–0.7 mm across between the uppermost 1 to 2 pinna pair, apex depressed, glabrous; pinnae 3 to 7 pairs/leaf, 9–20 mm long, 3–12 mm between pinna pairs; paraphyllidia absent; petiolule 0.9–2.1 mm long;

leaflets 12 to 26 pairs/pinna, opposite, 0.8–1.7 mm between leaflet pairs, linear, 1.2–2.9 × 0.5–0.9 mm, glabrous, lateral veins not obvious, 1 vein from the base, base oblique, truncate on one side, margins lightly ciliate, apex obtuse, midvein subcentral. Inflorescence a loosely 40- to 90-flowered cylindrical spike, 28–60 × 12–18 mm, solitary from the leaf axils; peduncles 5–16 × 0.3–0.8 mm, glabrous; receptacle not enlarged; involucre absent; floral bracts spatulate, 0.7–1.1 mm long, ciliate, persistent. Flowers sessile, white; calyx 5-lobed, 1.5–2.2 mm long, lightly puberulent; corolla 5-lobed, 3.5–6 mm long, glabrous to puberulent, lobes 1/5 the length of the corolla; stamens 100 to 140; stamen filaments 7.5–9.5 mm long, distinct; anther glands absent; ovary glabrous, stipe to 2.1 mm long. Legumes straight, flattened, not constricted between the seeds, oblong, 95–130 × 10–15 mm, coriaceous, transversely striated, glabrous, eglandular, dehiscent along both sutures; stipe 6–11 mm long; apex acute, short beaked; seeds uniseriate, with no pulp, light brown, ellipsoid, strongly flattened, 9–11 × 6–7 mm, smooth; pleurogram U-shaped, 3–5 mm across.

Habitat and distribution. *Pseudosenegalia riograndensis* is known locally in seasonally dry tropical forest at about 1300 m in the Rio Grande valley below Pasorapa, Provence Campero, Cochabamba, Bolivia.

Phenology. *Pseudosenegalia riograndensis* flowers from November through December.

IUCN Red List category. *Pseudosenegalia riograndensis* is assessed as Data Deficient (DD) at this time (IUCN, 2001). This species is apparently rare and is only known from two collections, the type and one other from a restricted region in Bolivia suggesting that the species may at least be Vulnerable (VU), perhaps Endangered (EN).

Specimen examined. BOLIVIA: **Cochabamba**: Campero, Bosque Termotropical inferior de *Neocardenasia herzogiana* y *Schinopsis haenkeana*, 1300 m, 24 Nov. 1999, *C. Antezana 1325* (NY).

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A Taxonomic Revision of *Orinus* (Poaceae) with a New Species, *O. intermedius*, from the Qinghai-Tibet Plateau

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Abstract. Six species have been described for the genus *Orinus* Hitchc. (Poaceae). Our analyses of morphological and genetic variation at the population level indicate that the genus should be reduced to three species, one of which, *O. intermedius* X. Su & J. Quan Liu, we describe as new from the Qinghai-Tibet Plateau. We include a complete taxonomic revision of the genus, a key to distinguish the three species, and geographic distribution and habitat data for each species.

Key words: *Orinus*, Poaceae, Qinghai-Tibet Plateau, species nova, taxonomic revision.

The genus *Orinus* Hitchc. (Poaceae, tribe Eragrostideae) has long culms with numerous nodes, sparse panicles, pedicellate and laterally compressed spikelets, and 3- to 5-veined lemmas with short awns. It seems to be closely related to the genera *Cleistogenes* Keng and *Tridens* Roem. & Schult. (Cai et al., 2004). It was established by Hitchcock (1933) based on the type species, *O. arenicola* Hitchc., which was first collected from the Kashmir region. However, Bor (1951) determined that *O. arenicola* was a synonym of *Diplachne thoroldii* Stapf, which had been previously described from Tibet (Hemsley, 1894). Therefore, the name of the type species, *O. arenicola*, was changed to *O. thoroldii* (Stapf) Bor. Later, another species, *O. anomalus* Keng ex Keng f. & L. Liou, was recognized by Keng (1957, 1959) and validly published in Keng and Liou (1960). Tzvelev (1968) transferred *Cleistogenes kokonorica* K. S. Hao to this genus, as *O. kokonoricus* (K. S. Hao) Tzvelev. Zhao and Li (1994) published details of a new species, *O. tibeticus* N. X. Zhao, based on specimens from Dingjie County in Tibet. Chen and Phillips (2006) accepted all four of these in their English-language *Flora of China* treatment. Recently, Zhang and Cai (2008) and Su and Cai (2009) reported two new species, *O. alticulmus* L. B. Cai & T. L. Zhang and *O. longiglumis* X. Su & L. B. Cai, from Xining City and Gonghe County of Qinghai Province, and Naidong County and Lang County in Tibet, respectively.

All six of the previously recognized species are mainly distributed in the Qinghai-Tibet Plateau (QTP) and adjacent regions. Although many scholars have researched *Orinus*, many shortcomings in taxonomic understanding still exist because of limitations such as fewer specimens, statistical analyses of morphological variations, etc., and because *Orinus* itself is quite variable. Especially today, with the increased number of samples and new taxa being found, the existing treatment of this genus is not adequate. Therefore, it is necessary to revise these taxa, clarify generic and species circumscriptions, and publish new information on the included taxa. Recently, we collected more than 700 individuals from 102 populations representing all six recognized species, and conducted morphological and genetic analyses at the population level (Su et al., 2015). Based on statistical analyses of character variation and molecular data, our results indicated that the six previously recognized species of the genus should be reduced to two, more broadly circumscribed, while a third should be described as a new species (Su et al., 2015). The two redefined species are distributed in the east and the west of the QTP, respectively, while the new species in the southeast of the QTP is an independently evolving lineage, probably at the early speciation stage (Su et al., 2015). Here, we formally describe this new species and revise the taxonomic treatment of the genus, based on examined specimens from the following major herbaria in China: CDBI, HNWP, KUN, LZU, PE, SCBI, WUK, XZ, and XZDC.

Orinus Hitchc., J. Wash. Acad. Sci. 23: 136. 1933. TYPE: *Orinus arenicola* Hitchc. [= *Orinus thoroldii* (Stapf) Bor.].

Perennial, loosely caespitose herbs. Rhizomes cylindrical, multinodal, with many larger or few smaller scales. Culms erect. Leaf sheaths longer than internodes; leaf blades flat or slightly involute at the margins. Inflorescence a sparse panicle of few to several ascending racemose branches along a central axis. Spikelets shortly pedicellate, laterally compressed, 1 to several florets. Rachilla internodes pubescent or glabrous, disarticulating above glumes and between florets. Glumes thin, the first glume 1-nerved, the second glume 3-nerved. Lemmas lanceolate-oblong, 3-veined. Paleae equal to or slightly shorter than lemmas, with emarginated or bidentate apex, ± ciliolate along keels, ± hairy between keels. Caryopses brown or yellowish brown, narrow oblong or cylindrical.

KEY TO THE SPECIES OF *ORINUS*

1a. Lemmas densely villous all over; glumes sparsely pilose; leaf blades and sheaths densely villous throughout; spikelets dark brown or purplish brown ..... *O. thoroldii* (Stapf) Bor
1b. Lemmas sparsely pilose or pubescent only along margins and lower keel; glumes glabrous; leaf blades and sheaths glabrous; spikelets stramineous, green or white 2
  2a. Rhizomes with many larger scales, numerous hairlike secondary roots on the fibrous roots; spikelets usually 1- to 3-flowered; distributed in the eastern QTP ..... *O. kokonoricus* (K. S. Hao) Tzvelev
  2b. Rhizomes with a few smaller scales, few secondary roots on the fibrous roots; spikelets usually 3- to 6-flowered; distributed in the southeastern QTP..... *O. intermedius* X. Su & J. Quan Liu

1. Orinus intermedius X. Su & J. Quan Liu, sp. nov. TYPE: China. Xizang: Mangkang Co., Yela Mtn., Dengba village, 29°32′27.2″N, 98°15′3.3″E, 3522 m, 26 Aug. 2012, *X. Su 2012016* (holotype, HNWP!; isotype, HNWP!). Figure 1.

Haec species vaginis laminisque foliaribus glabris, glumis glabris, spiculis stramineis viridulisve etiam lemmatibus ad margines carinamque tantum parce pilosis pubescentibusve ab *Orino thoroldii* (Stapf) Bor, ab *O. kokonorico* (K. S. Hao) Tszvelev spiculis plerumque 3- ad 6-floris, ab ambabus rhizomate esquamoso distinguitur.

Perennial, loosely caespitose herbs. Rhizomes 2.6–21.5 cm, 1.5–2.5 mm diam. at base, cylindrical, multinodal, with few smaller scales and few secondary roots on the fibrous roots. Culms erect, 25.3–99.6 cm tall, 1.1–2.5 mm diam., with 2 to 6 nodes, glabrous under nodes. Leaf sheaths glabrous, longer than internodes; ligules membranous, ca. 1.0 mm, laciniate; leaf blades flat or slightly involute, 5.3–24.5 cm × 1.0–4.0 mm, glabrous abaxially and adaxially. Panicles slightly spreading, 6.1–31.3 cm, with 3 to 17 racemose branches; branches solitary, 1.0–12.5 cm, glabrous. Spikelets stramineous or green, 4.2–13.0 mm, 3- to 6-flowered; rachilla internodes glabrous, ca. 1.0 mm; glumes lanceolate, glabrous, keeled on back, membranous along the margins, obtuse at apex, shorter than adjacent florets; first glumes 1-nerved, 2.5–5.0 mm, second glumes 3-nerved, 3.0–6.5 mm; lemmas lanceolate, slightly keeled on back, 3-nerved, sparsely pilose or pubescent along or near keels and veins, obtuse at apex; lemmas of first florets 3.5–6.0 mm; paleae subequal to lemmas, with emarginate apex, sparsely pilose at base or along keels; anthers orange or yellow, 1.6–2.9 mm. Caryopses brown, narrowly oblong, 1.9–2.9 mm.

Distribution and habitat. *Orinus intermedius* is known from localities in Qinghai, Sichuan, and Xizang in the southeast of the QTP, China (Fig. 2). The type locality is a dry mountain slope at 3522 m altitude. Several paratypes were collected from steppes or dry mountain slopes at alt. 3300–3900 m. All of these localities have relatively dry soils.

Discussion. *Orinus intermedius* is classified in the genus *Orinus* based mainly on its morphological characteristics (Hitchcock, 1933; Bor, 1951; Keng, 1957, 1959; Liou, 1987; Yang, 1990; Lu, 1999; Su & Cai, 2009). The species has long rhizomes, 1- and 3-nerved glumes, sparsely pilose or pubescent lemmas, and panicles composed of racemose branches. The new species is most similar to *O. kokonoricus*, in this study defined by its glabrous culms, leaf blades and sheaths, stramineous spikelets, glabrous and keeled glumes, and sparsely pilose or pubescent lemmas. However, the new species clearly differs from both existing species as herein circumscribed (Table 1). It differs from *O. thoroldii* in having few smaller scales in rhizomes and few secondary roots on the fibrous roots, paler spikelets, and lesser or absent indument on the culm, leaf blade, leaf sheath, glumes, and lemmas. It is distinguished from the closely related *O. kokonoricus* by its few smaller scales in rhizomes and few secondary roots on the fibrous roots and spikelets with usually three to six florets.

Paratypes. CHINA. **Qinghai:** Banma Co., on the way from Dari to Banma Co., 18 km from Banma Co., 33°1′28.9″N, 100°41′52.3″E, 3534 m, 16 Aug. 2013, *X. Su 2013032* (HNWP, KUN). **Sichuan:** Aba Co., N Mtn., 3280 m, 26 Sep. 1971, *Tibet Medicine Exped. 980* (HNWP, PE); Maikun Xiang, 32°54′45.0″N, 101°46′59.3″E, 3379 m, 4 Oct. 2011, *X. Su 2011285* (HNWP, KUN); ca. 1 km to

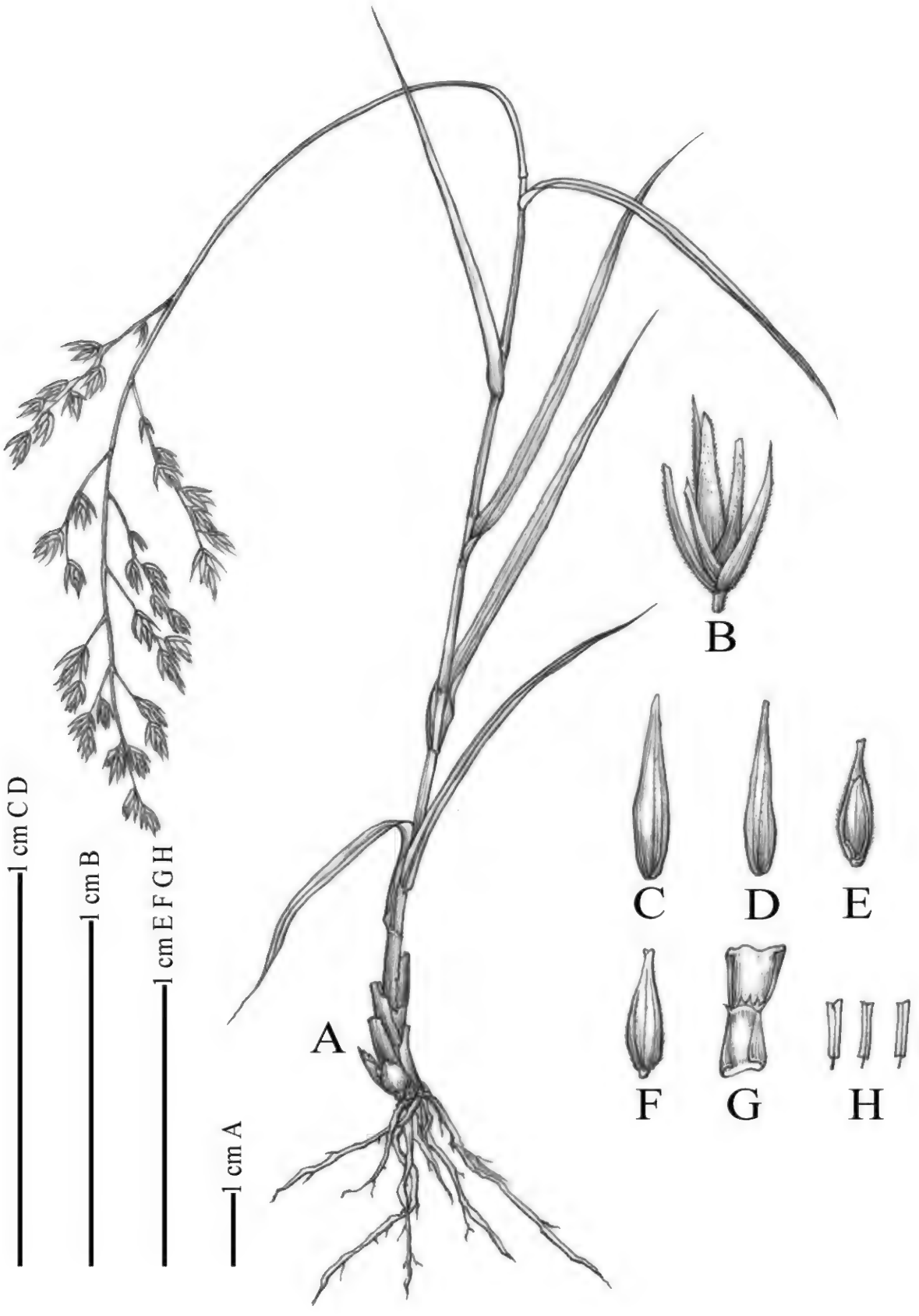

Figure 1. *Orinus intermedius* X. Su & J. Quan Liu. —A. Mature plant with scaleless rhizomes. —B. Spikelet. —C. First glume. —D. Second glume. —E. First floret, ventral view. —F. First floret, dorsal view. —G. Junction of sheath and blade showing ligule. —H. Anthers. Drawn by Ming-Qiu Liu from the holotype *X. Su 2012016* (HNWP).

the E of Maikun Xiang, 32°54′28.2″N, 101°46′25.5″E, 3319 m, 21 Aug. 2012, *X. Su 2012001* (HNWP, KUN), near Chali Government, 32°45′26.7″N, 102°3′33.8″E, 3358 m, 21 Aug. 2012, *X. Su 2012003* (HNWP, KUN); Luhuo Co., near Weiwo police station, 31°38′35.0″N, 100°17′15.9″E, 3573 m, 19 Aug. 2013, *X. Su 2013058* (HNWP, KUN); Xiangtang Co., on the way from Zongke to Zongta Xiang, 31°46′16.2″N, 100°58′57.1″E, 3478 m, 23 Aug. 2012, *X. Su 2012007* (HNWP, KUN); Daofu Co., Longdeng Xiang, Jisizhong village, 30°37′17.7″N, 101°24′15.5″E, 3507 m, 24 Aug. 2012, *X. Su 2012008* (HNWP, KUN); Wari Distr., 3600 m, 24 Aug. 1974, *5918* (HNWP, KUN). **Xizang:** Mangkang Co., Yela Mtn., Dengba village, 29°32′28.8″N, 98°15′18.5″E, 3852 m, 21 Aug. 2013, *X. Su 2013075* (HNWP, KUN).

2. Orinus kokonoricus (K. S. Hao) Tzvelev in Rast. Tsentr. Azii 4: 112. 1968.

Cleistogenes kokonorica K. S. Hao, Bot. Jahrb. Syst. 68: 582. 1938. *Diplachne kokonorica* (K. S. Hao) Conert, Bot. Jahrb. Syst. 78: 230. 1959. *Kengia kokonorica* (K. S. Hao) Packer, Bot. Not. 113: 293. 1960. TYPE: China. Qinghai: Kokonor, 3440 m, 24 Aug. 1930, *Hopkingson 998* (holotype, B [image!]).

Orinus anomalus Keng ex Keng f. & L. Liou, Acta Bot. Sin. 9(1): 68. 1960, syn. nov. TYPE: China. Sichuan, July

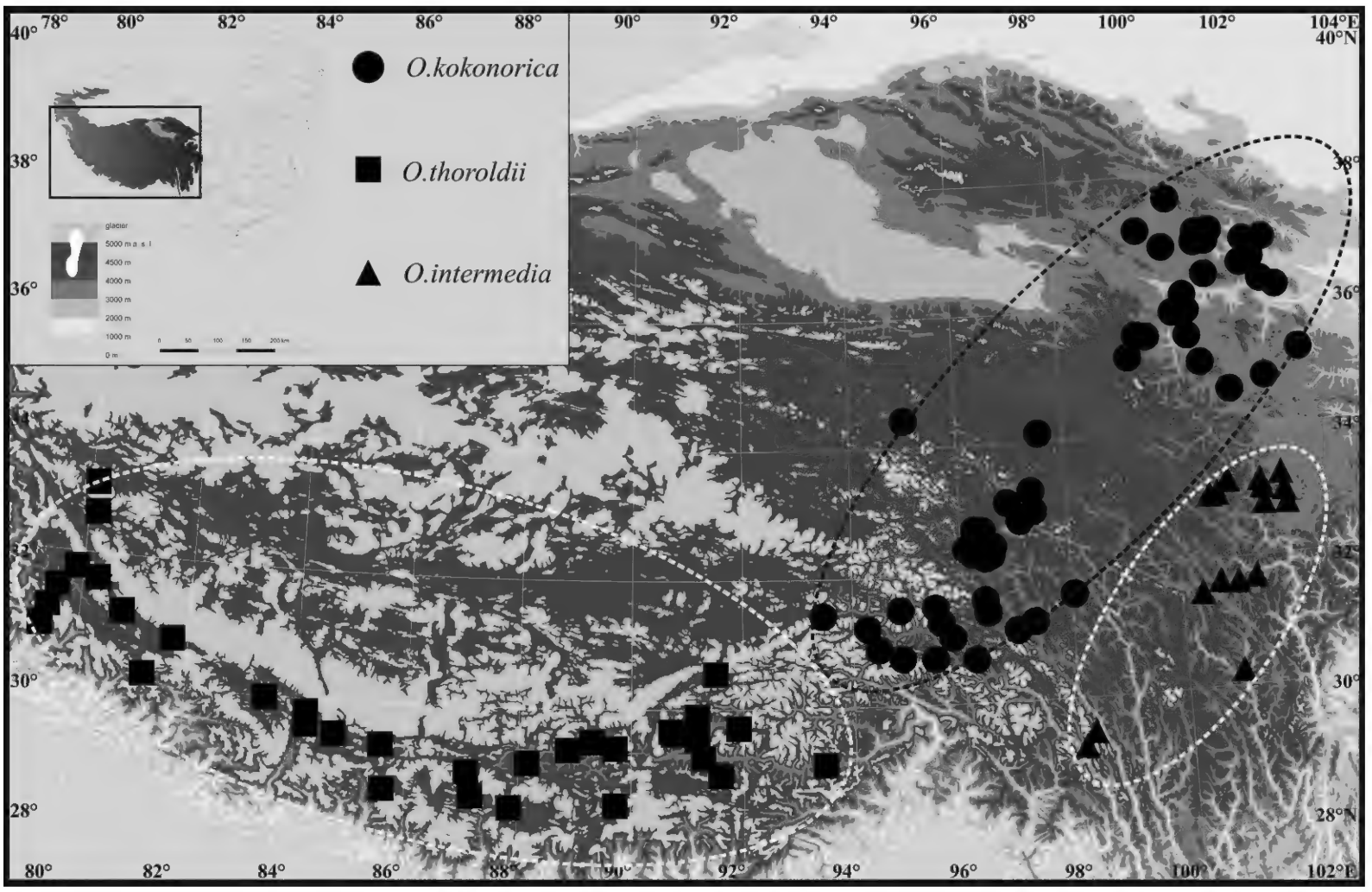

Figure 2. Geographical distribution of three *Orinus* species on the Qinghai-Tibet Plateau.

1940, *G. L. Qu 7469* (holotype, NJU [image!]; isotypes, HNWP!, PE!).

Orinus alticulmus L. B. Cai & T. L. Zhang, Novon 18: 275–278. 2008, syn. nov. TYPE: China. Qinghai: Xining City, Yangjiazhai, near Xining Botanical Garden, 36°36′N, 101°48′E, 2450 m, 14 Aug. 1985, *Y. H. Wu 1913* (holotype, HNWP!; isotype, PE!).

Distribution and habitat. *Orinus kokonoricus* is native to China, including Qinghai, Sichuan, and Gansu. Its habitat is dry mountain slopes and steppe at 2400–4200 m.

Specimens examined. CHINA. **Gansu:** Sunan Co., Haiya Ditch, 2750 m, 14 July 1960, *Z. Y. Zhang 3284* (WUK); Dahe Distr., Beiquanmen Ditch, 2900 m, 25 Aug. 1967, *Hexi Exped. 476* (PE); Laihaiyajing, 2750 m, 14 July 1960, *Qinghai-Gansu Exped. 3284* (PE); Wuwei, Xiying River, forest farm, 2500 m, 4 Oct. 1964, *2077* (PE). **Qinghai:** Chengduo Co., Labu commune, Xieqionglong, 3900 m, 11 Sep. 1983, *Y. Y. Liu 83-440* (HNWP); Datong Co., Baoku, 2700 m, 27 July 1989, *Z. H. Zhang et al. 4686* (HNWP); Gangcha Co., Ji Er Men Xiang, 3380 m, *S. X. Wang 101* (HNWP); Bird Island Station, 3350 m, 26 Aug. 1988, *Vegetation Geography Group 1214* (HNWP); Gonghe Co., *P. C. Kuo & S. X. Wang 6476*, *6486* (HNWP); *K. Z. Zhang 631016* (HNWP); Gonghe Co., Longyangxia, N shore canyon, 2700 m, 19 Aug. 1987, *Longyangxia Exped. 107* (HNWP); Jiayi Xiang, SE shore of Kolo Nor (Qinghai Lake), 36°35′15″N, 100°29′26″E, 3440 m, 21 Aug. 1993, *T. N. Ho 1524* (HNWP, PE); Yitala, alt. 3000 m, 15 July 1965, *P. C. Kuo 6086* (HNWP); Heka, Karihong Mtn., 3200 m, 17 July 1965, *P. C. Kuo 6100* (HNWP); near Qinghai Lake, 3500 m, July 1985, *P. C. Kuo 27803* (HNWP); Guinan Co., Hanmachang, 3100 m, 22 July 1967, *B. W. Li & K. Z. Zhang 007* (HNWP); Haiyan Co., *Vegetation Geography Group 1264*, *1301* (HNWP); *G. C. Chen & S. Z. Sun 686* (HNWP); Henan Co., *L. H. Zhou & L. N. Sun 2287* (HNWP); Nangqian Co., People's Government of Juela Xiang, 4100 m, 25 Aug. 1965, *Y. C. Yang 01357* (HNWP); Nangqian Co., along W side of the Zaqu (upper Mekong), on rd. betw. Nangqian & Yushu Co., 32°17′ N, 96°28′ E, 3550 m, 1 Sep. 1996, *T. N. Ho, B. Bartholomew, M. Watson & M. Gilbert 2759* (PE); Qilian Co., Dove hole, 21 July 1962, *Z. Y. Qin 003613* (HNWK), *1390* (HNWK, WUK); Tongde Co., near hillside in grassland station, 22 Aug. 1990, *Y. H. Wu et al. 7267* (HNWP); Wulan Co., Chaka, 3200 m, 12 Aug. 1959, *Qinghai-Gansu Exped. 1392* (HNWK, PE, WUK); Chaka, 3100 m, 12 Aug. 1959, *Qinghai-Gansu Exped. Z. Y. Zhang 1359* (PE, WUK); Xining City, Xining Botanical Garden, N Mtn., 2600 m, 5 Aug. 1985, *Y. H. Wu 1866* (HNWP); Dayou Mtn., 2320 m, 18 July 1989, *Z. H. Zhang et al. 3104* (HNWP); Xichuanxixing Garden, 2455 m, 16 July 1989, *Z. H. Zhang et al. 3105*, *3106*, *3178* (HNWP); Xichuanxixing Garden, 2498 m, 16 July 1989, *Z. H. Zhang et al. 3107* (HNWP); Xinghai Co., Tangnai River, 2800 m, *Anonymous 243* (HNWP); Heka town, Ningqu Mtn., 3600 m, 17 Aug. 1965, *T. N. Ho 00483* (HNWP); Heka town, Yangqu, 3500 m, 25 Aug. 2001, *Y. H. Wu 20357*, *20425*, *20429*, *20438*, *20491* (HNWP); Heka beach, 3270 m, 5 July 1983, *Z. W. Zhang 2080* (WUK); Tiebujia, alt. 3325 m, 4 Aug. 1961, *010* (PE); Zaduo Co., near Angsai Government, 3850 m, 21 Aug. 1965, *S. W. Liu 00475* (HNWP); Zeku Co., Ningxiu Xiang, Ningxiu beach, 3500 m, 11 Sep. 1970, *S. W. Liu 1769* (HNWP). **Sichuan:** Aba Co., 16 July 1974, *Anonymous 05585* (PE); Dege, 3 km N of Manigange, 3900 m, 6 Aug. 1982, *Z. X. Tang, X. W. Tian & Q. G. Sun 657* (PE); Dengke Co., 3400 m, 22 Aug. 1974, *Anonymous 7654* (PE); Ganzi Co., Rongpen temple,

Table 1. Morphological differences among three *Orinus* Hitchc. species.

Character	*O. thoroldii* (Stapf) Bor	*O. kokonoricus* (K. S. Hao) Tzvelev	*O. intermedius* X. Su & J. Quan Liu
Plant	13.6–95.8 cm tall, with 1 to 10 nodes, culms and leaf blades and sheaths densely villous or pilose throughout	18.0–84.7 cm tall, with 2 to 5 nodes, culms and leaf blades and sheaths glabrous	25.3–99.6 cm tall, with 2 to 6 nodes, culms and leaf blades and sheaths glabrous
Rhizome	with many larger scales, 5.0–25.0 cm long	with many larger scales, 1.5–18.0 cm long	with few smaller scales, 2.6–21.5 cm long
Panicle	1.8–30.0 cm long, with 1 to 10 branches	3.2–26.5 cm long, with 3 to 15 branches	6.1–31.3 cm long, with 3 to 17 branches
Spikelet	dark brown or purple brown, 5.5–11.5 mm long, 2- to 6-flowered	stramineous or white, 3.5–15.5 mm long, 1- to 3-flowered	stramineous or green, 4.2–13.0 mm long, 3- to 6-flowered
Glume	sparsely pilose along or near the keels and veins, the lower glumes 2.5–6.5 mm long and upper glumes 3.5–8.0 mm long, markedly shorter than the adjacent florets	glabrous, the lower glumes 2.1–5.5 mm long and upper glumes 2.5–6.0 mm long, shorter than the adjacent florets	glabrous, the lower glumes 2.5–5.0 mm long and upper glumes 3.0–6.5 mm long, shorter than the adjacent florets
Lemma	densely villous, the lower lemmas 3.9–7.0 mm long	sparsely pilose or pubescent, the lower lemmas 3.0–6.0 mm long	sparsely pilose or pubescent, the lower lemmas 3.5–6.0 mm long
Palea	slightly shorter than the lemmas, densely villous at the base	equal to or slightly shorter than the lemmas, sparsely pilose at the base	subequal to the lemmas, sparsely pilose at the base or along the keels
Anther	yellow or purple yellow, 2.4–3.6 mm long	orange, 1.5–2.5 mm long	orange or yellow, 1.6–2.9 mm long
Caryopsis	2.3–3.2 mm long	1.6–2.7 mm long	1.9–2.9 mm long

3570 m, 31 Aug. 1982, *Z. X. Tang 0872* (PE); Luhuo Co., Qiaqia, 3480 m, 24 Aug. 1980, *Anonymous 28515* (HNWP); Songpan Co., Chimney, 3100 m, 2 Aug. 1983, *Z. X. Tang 1598* (PE); Wenchuan Co., Kezhi Xiang, N Tieling Group, 1500 m, 3 Sep. 1983, *1928* (PE). **Xizang**: Bomi Co., 2700 m, 2 July 1973, *Inst. Biol. Xizang Exped. 0787* (PE); Lasa City, N Mtn., 4100 m, 6 Oct. 1972, *Xizang Med. Pl. Exped. 2061* (PE); Linzhi Co., 25 July 1977, *P. C. Kuo & W. Y. Wang 21917* (HNWP).

Discussion. Previous scholars thought that *Orinus anomalus* differed from *O. kokonoricus* in that lemmas of *O. kokonoricus* were sparsely pilose or pubescent only on the lower parts (Tzvelev, 1968; Yang, 1990; Lu, 1999; Chen & Phillips, 2006). However, this viewpoint was originally opposed by Cai (2004). Based on our recent morphological studies and field observations, the difference between *O. kokonoricus* and *O. anomalus* is inconspicuous. In the past, character differences of spikelets, florets, glumes, and lemmas were pointed out, but we now know that there are significant overlaps in the length of spikelets and glumes, and the number of florets. Further, there is transition between locations of lemma indument. It is clear that the taxonomic characters previously used are unstable, so the previously recognized species, *O. anomalus*, is very probably a synonym of *O. kokonoricus*. Similarly, *O. alticulmus* differed from *O. kokonoricus* in the shape of panicles and number of florets (Zhang & Cai, 2008). *Orinus alticulmus* has slightly effuse panicles, longer spikelets (8–10 mm) usually with three florets, and paleae usually longer than lemmas. In particular, *O. alticulmus* differs from *O. kokonoricus* by its taller culms (usually 40–75 cm). Nevertheless, we found that those morphological characters could not distinguish these two species, because the recognized characters of *O. alticulmus* fall within the range of morphological variation of *O. kokonoricus*. For example, culm height of most specimens of *O. kokonoricus* exceeds 40 cm, at the extreme reaching 84.7 cm; the length of most spikelets is 5.2–14.5 mm, with one to three florets. Thus, there are many overlapping characters between *O. kokonoricus* and *O. alticulmus*. In specimens identified as *O. alticulmus*, many morphological characters are also not consistent with the original description of that species. For instance, culm height is between 19.1 and 76.0 cm; spikelet length ranges from 3.5 to 10.2 mm, with one to three florets. We think that variation in these characters may be related to the region and habitat of specimens. Therefore, *O. alticulmus* is treated as a synonym of *O. kokonoricus*.

3. Orinus thoroldii (Stapf) Bor, Kew Bull. 6: 454. 1951 [1952].

Diplachne thoroldii Stapf. in Hemsl., J. Linn. Soc., Bot. 30: 121–122. 1894, as "*Thoroldi*." *Cleistogenes thoroldii* (Stapf) Roshev., Fl. Kirgh. 2: 107. 1950. *Kengia thoroldii* (Stapf) H. Yu & N. X. Zhao, Ann. Bot. Fenn. 42: 55. 2005. TYPE: China. Tibet [Xizang], sandy soil in valleys, 15,800 ft, *Thorold 120* (holotype, K!).

Orinus arenicola Hitchc., J. Wash. Acad. Sci. 23: 136. 1933. TYPE: [Pakistan], Western Himalayas, Kashmir, Ladak, Tsaka, 4700 m, collected in bare sand, 18 July 1931, *Koelz 2365* (holotype, US-1535771 [image!]).

Orinus tibeticus N. X. Zhao, Acta Bot. Yunnan. 16(3): 228, f. 1. 1994, syn. nov. TYPE: China. Xizang: Dingjie Co., 4400 m, 16 July 1960, *G. X. Fu & J. W. Zhang 0107B* (holotype, PE!; isotype, SCBI [image!]).

Orinus longiglumis X. Su & L. B. Cai, Ann. Bot. Fenn. 46(1): 144–145. 2009, syn. nov. TYPE: China. Xizang: Naidong Co., Jieba, 29°15′N, 91°43′E, 3500 m, 28 July 2005, *L. B. Cai & C. R. Luosang 002* (holotype, HNWP!; isotype, HNWP!).

Distribution and habitat. *Orinus thoroldii* is native to regions of China including Qinghai, Xinjiang, and Xizang; it is also known from the Himalayan region of Pakistan. It is found in arid sand, sandy wasteland, or gravelly steppe, sometimes with *Artemisia* L., or fixed sand dunes, at altitudes of 3000–4700 m.

Specimens examined. CHINA. **Qinghai:** Chengduo Co., *X. J. Gou & Y. Y. Liu 83-440* (HNWP), *Y. C. Yang 723* (HNWP); Datong Co., *Z. H. Zhang et al. 4686* (HNWP); Dulan Co., *Qinghai-Gansu Exped. 1392* (HNWP); Gangcha Co., *Vegetation Geography Group 1204* (HNWP), *S. X. Wang 101* (HNWP); Gonghe Co., *Vegetation Geography Group 644*, *1214* (HNWP), *P. C. Kuo 6086*, *27803* (HNWP), *Longyangxia Exped. 107* (HNWP), *H. B. G. 1524* (HNWP); Guide Co., *T. N. Ho 1016* (HNWP); Guinan Co., *B. W. Li & K. Z. Zhang 007* (HNWP); Haiyan Co., *G. C. Chen 005* (HNWP); Nangqian Co., People's Government of Juela Xiang, Back Mtns., 4100 m, *Y. C. Yang 01357* (HNWP); Qilian Co., *Z. Y. Qin 1370* (HNWP), South Mtn., 3400 m, 10 Sep. 1975, *P. C. Kuo & W. Y. Wang 12561* (PE); Tongde Co., *Y. H. Wu et al. 6773*, *6814*, *7208*, *7267* (HNWP); Tongren Co., *S. W. Liu & D. S. Luo 1164* (HNWP); Xinghai Co., *P. C. Kuo 6100* (HNWP), *T. N. Ho 0330*, *0483* (HNWP), *Anonymous 243* (HNWP); Xining City, *Z. H. Zhang et al. 3104*, *3105*, *3106*, *3107*, *3178* (HNWP), *Y. H. Wu 1866* (HNWP); Yushu Co., *Z. D. Wei 21854* (HNWP), *Anonymous 0445* (HNWP); Zaduo Co., *S. W. Liu 0475* (HNWP), *Anonymous 0723* (HNWP); Zeku Co., *S. W. Liu 1769* (HNWP). **Xinjiang:** Riqima Co., 4500 m, 4 Sep. 1987, *Qinghai-Xizang Exped. 1330* (PE). **Xizang:** Bomi Co., 4600 m, 3 June 1966, *Y. T. Zhang & K. Y. Lang s.n.* (PE); Changdu Co., agricultural experiment field, July 1954, *Changdu farm 7* (PE); Cuoqin Co., 4350 m, 26 July 1974, *Qinghai-Xizang Exped. 1964* (PE), NE City, near Telilangmu Lake, 4600 m, 15 Sep. 1976, *K. Y. Lang 10299* (PE); *C. Y. Wu et al. 711* (HNWP); Dangxiong Co., near Yangbajin hot spring, 4300 m, 21 Sep. 1975, *Xizang Exped. 7560* (HNWP, PE); Yangbajin, 4100 m, 18 Aug. 1985, *J. H. Tong 1-125* (PE), Yangbajin, NW roadside, 4650 m, 14 July 1960, *G. X. Fu 311* (PE); Baling Town, Tangmagang, 4780 m, 11 Aug. 1985, *D. X. Su 022* (PE); 9 Sep. 1985, *J. H. Tong 138A* (PE); Dingjie Co., Kangpa SW, 4500 m, 13

July 1961, *Xizang Exped. 1614* (PE); on the way from Jinlong to Duozha, 4650 m, 15 July 1960, *G. X. Fu & J. W. Zhang 1011* (PE); on the way from Duozha to Dingjie Co., 4400 m, 16 July 1960, *G. X. Fu 1017* (PE); Kangpa, Zongxiadanggeliushang, 14 Aug. 1953, *B. Q. Zhong 6110* (PE); Kangpa, 12 Aug. 1953, *B. Q. Zhong 7398*; 4210 m, 17 June 1975, *Qinghai-Xizang Exped. 3986* (PE); Dingri Co., encampment, 4600 m, 16 June 1990, *Chinese-Japanese Exped. T604, T606* (PE); 17 June 1990, *Chinese-Japanese Exped. T638, T640* (PE); 23 June 1990, *Chinese-Japanese Exped. T871* (PE); Gaize Co., 4500 m, Aug. 1972, *F. Z. Li 018* (PE); near Uma Distr., 4500 m, 7 Sep. 1976, *Qinghai-Xizang 12478* (PE); Zhari Namco, 4600 m, 15 Sep. 1976, *Qinghai-Xizang 12578* (PE); Gaize Co., near the county, 4400 m, 6 Sep. 1974, *Xizang Exped. 4307* (HNWP); near the beach of Mami Distr., 4500 m, 7 Sep. 1976, *K. Y. Lang 10142* (HNWP); NE stone hillside of Cantor Distr., 4600 m, 11 Sep. 1976, *K. Y. Lang 10225* (HNWP); Ge'er Co., near Mentu Distr., 4400 m, 9 July 1976, *Qinghai-Xizang Exped. 76-7964* (PE); near Mentu Distr., 4530 m, 9 July 1976, *Qinghai-Xizang Exped. 13208* (PE); Geji Co., near Yanhu Distr., 4350–4450 m, 24 Aug. 1976, *Qinghai-Xizang Exped. 13535* (PE); Gonggar Co., 4510 m, 7 July 1975, *C. Y. Wu, S. K. Chen, Q. Du & S. L. Lu 75-0711* (PE); Jilong Co., 14 km W of Changguo, 4650 m, 21 July 1975, *Qinghai-Xizang Exped. 5437* (PE); near Jilong Co., 4100–4300 m, 28 July 1975, *Qinghai-Xizang Exped. 5606* (PE); 4400–4500 m, 24 Sep. 1990, *B. S. Li, H. Li & Y. Yang 13964, 13965B* (PE); Kangma Co., Gala Lake basin, 4400 m, 6 July 1961, *Xizang Exped. 1577* (PE); Lang Co., the white village rd., 3050 m, 17 Aug. 1972, *Xizang Med. Pl. Exped. 4415* (PE); Lasa City, 3700 m, 25 July 1977, *P. C. Kuo & W. Y. Wang 22057* (HNWP); Three Back Mtn., 3750 m, 21 May 1975, *75-41* (PE); North Mtn., 4100 m, 6 Oct. 1972, *Xizang Med. Pl. Exped. 2061* (PE); W suburb, 3700 m, 16 Sep. 1970, *P. C. Kuo 8116* (PE); Lazi Co., Phuntsholing, W hill, 23 Aug. 1952, *B. Q. Zhong 7414* (PE); on the way from Jiadeng to Phuntsholing, 23 Aug. 1952, *B. Q. Zhong 7411* (PE); W slope of Jiaqingze, 14 June 1952, *B. Q. Zhong 7279* (PE); Longzi Co., 4000 m, 4 Aug. 1974, *Qinghai-Xizang Exped. 906, 2231* (PE); Naidong Co., Zedang hostel, 3650 m, 15 July 1975, *C. Y. Wu, S. K. Chen, Q. Du & S. L. Lu 75-0762* (PE); Pulan Co., near Mapam Yumco, 4530 m, 23 Aug. 1974, *Inst. Biol. Xizang Exped. 4146* (HNWP); Rikaze City, NE, 4000 m, 26 July 1972, *Xizang Med. Pl. Exped. 795* (HNWP, PE); Da Zhu Ka, 3700 m, 25 Aug. 1963, *J. X. Yang 2284* (HNWP, WUK); near Yarlung Zangbo, 3860 m, 30 July 1975, *75-865* (PE); NE, 4000 m, 26 July 1972, *Xizang Med. Pl. Exped. 795* (PE); 2 km W from the Wild Horse Gang Tractor farm, 3800 m, 17 July 1961, *J. W. Zhang 2633* (PE); Ritu Co., Duoma Town, 4500 m, 4 Sep. 1987, *Qinghai-Xizang Exped. Y. H. Wu 1330* (HNWP, PE); Xiaqulong, 4400 m, 12 July 1974, *Xizang Exped. 3505* (HNWP); near Rebang Distr., 4320 m, 28 Aug. 1976, *Qinghai-Xizang Exped. 76-9133* (PE); Shenzha Co., near NW corner of Qilin Lake, 4650 m, 1 Sep. 1976, *Qinghai-Xizang Exped. 12414* (PE); Zhada Co., Duojidong, 4000 m, 7 Aug. 1974, *Inst. Biol. Xizang Exped. 3844* (HNWP, PE); near Zhada Co., 4000 m, 13 Aug. 1974, *Xizang Exped. 3939* (HNWP); S & N hillside, 3600 m, 24 July 1974, *Qinghai-Xizang Exped. 1904* (PE); Zhanang Co., on the way from Zedang to Qushui Co., 3450 m, 28 May 1986, *T. Naito et al. 1508* (PE); Sangyingu Mtn., July 1960, *G. X. Fu 747* (PE); Zhongba Co., near Guisang, 4800 m, 24 July 1975, *Xizang Exped. 6450* (HNWP); 4600 m, 24 July 1975, *Qinghai-Xizang Exped. 5445* (PE); NE hilly country of Guisang, 4500–5000 m, 25 July 1975, *Qinghai-Xizang Exped. 5508* (PE); near Zhongba Co., 4650 m, 8 Aug. 1975, *Qinghai-Xizang Exped. 7234* (PE); Hongqi community, 18 July 1975, *44-7235* (PE).

Discussion. *Orinus tibeticus* and *O. longiglumis* are not essentially different from *O. thoroldii* in geographical distribution or external morphology. The two are distributed in Xizang (Tibet) and usually occur only in high arid sand, sandy wasteland, or gravelly steppe, between 3040 and 4400 m. The type specimen of *O. tibeticus* was collected from Dingjie County, at 4400 m, while *O. longiglumis* was sampled from Naidong and Lang counties, at 3040–3650 m. These two are known only from several small localities in Xizang, while *O. thoroldii* has a wide distribution, occurring throughout the QTP (Cai et al., 2004). It usually grows in high arid sand, sandy wasteland, or gravelly steppe or fixed sand dunes, at 3051–4687 m. Its distribution range therefore includes that of *O. tibeticus* and *O. longiglumis*, and its habitat is very similar.

In external morphology, characters supposed to distinguish the three species show continuous variation. According to the protologue, the type of *Orinus tibeticus* differs from *O. thoroldii* in having culms covered with densely villous or pilose indument and larger spikelets, (8–)9–11 mm long. Through study of herbarium specimens and field observation, we found culms of *O. thoroldii* also covered with densely villous or pilose indument, and other characters including longer spikelets were often seen. Thus, the characters used to establish *O. tibeticus* appear to be transitional traits, possibly partly environmental in origin, and are not enough to differentiate species. Therefore, *O. tibeticus* should be reduced to a synonym of *O. thoroldii*. Likewise, *O. longiglumis* is also similar to *O. thoroldii*, only differing by having longer panicles, glumes, and anthers, and paleae that are shorter than the lemmas. As in the case of *O. tibeticus*, these variable characters are also not enough to justify interspecific delimitation. Therefore, *O. longiglumis* should be treated as a synonym of *O. thoroldii* as well.

The basionym of *Orinus thoroldii*, *Diplachne thoroldii*, is commonly attributed to Stapf ex Hemsl., as it appears in a paper by Hemsley (1894). However, this seems to be an error. Hemsley credited the name to Stapf and elsewhere in the paper (l.c.: 107) acknowledged by name three colleagues at Kew, including Stapf, for "assistance." Under the International Code of Nomenclature (McNeill et al., 2012), the name should therefore be attributed to Stapf (see Art. 46.2, Ex. 7).

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Another Taxonomic Review of the Neotropical Genus *Joosia* (Rubiaceae, Cinchoneae)

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Abstract. Recent botanical explorations in western tropical South America provide new documentation of *Joosia* H. Karst., which has clarified some species identities and discovered some new species. Eighteen species are recognized here, with *J. umbellifera* H. Karst. circumscribed more narrowly than in previous taxonomies and *J. panamensis* Dwyer and *J. ulei* Steyerm. separated from it. Two new nomenclatural combinations are made: *J. loretensis* (Standl.) C. M. Taylor is based on *Rondeletia loretensis* Standl., and *J. sericea* (Standl.) C. M. Taylor is based on *Ladenbergia sericea* Standl. and is an older name for *J. multiflora* L. Andersson. Three species are newly described here: *J. capitata* C. M. Taylor from northern Peru, with subcapitate inflorescences and dense hirtellous to hirsute pubescence; *J. confusa* C. M. Taylor from Ecuador and Peru, with dichasial axes and shallowly lobed calyx limbs; and *J. frondosa* C. M. Taylor from Colombia, with enlarged whitened bracts and calyx lobes. *Joosia* has its center of species diversity in montane Ecuador and Peru; it is now documented also from Bolivia, where *J. sericea* is found, and from Venezuela, but that material is inadequate for identification to species.

Key words: Bolivia, Cinchoneae, Colombia, Costa Rica, Ecuador, *Joosia*, Neotropical floristics, Panama, Peru, Rubiaceae, Venezuela, World Flora Online.

Joosia H. Karst. comprises 18 species of Neotropical shrubs and small trees found in wet vegetation from near sea level to montane forest, from Costa Rica through the Andes and western Amazon basin to western Venezuela and northern Bolivia. *Joosia* is characterized by a lack of raphide crystals in the tissues; a woody habit; opposite leaves with lineolate tertiary venation; interpetiolar, ligulate, deciduous, generally obtuse to rounded stipules that are held flattened together and erect in bud; subsessile to usually pedunculate inflorescences that are borne in a terminal position and have dichasial or often monochasial axes and usually reduced bracts; 4- or 5-merous, distylous, sessile to shortly pedicellate, fragrant flowers; salverform, green to white or pink, externally strigose corollas with the lobes valvate in bud and usually elaborately appendaged along their margins; and cylindrical to obovoid, stiff-textured, septicidal capsules containing numerous small, flattened, winged seeds. Several *Joosia* species have some characters that are exceptions to these generalizations, as in most Rubiaceae genera, but the combination of the distinctive leaf venation and stipule arrangement diagnoses this genus in the Neotropics. The flowers of *Joosia* are distylous and reported to be fragrant, and in at least some species are nocturnal (e.g., *J. umbellifera* H. Karst., *S. Knapp & J. Mallet 8375*), though the floral biology of this genus is not well known. Morphological (Andersson, 1995) and molecular (Andersson & Antonelli, 2005; Manns & Bremer, 2010) data support the inclusion of *Joosia* in the tribe Cinchoneae, and the molecular analyses found *Joosia* to be sister to the other genera of this tribe. The molecular analyses also found *Joosia* to be monophyletic, but only two species were included in those analyses. The center of *Joosia*'s species diversity is in the Andes of Ecuador and Peru. The bark of *Joosia* is described as bitter (Steyermark, 1975), and at least some species have some antimalarial properties and are locally used as fever remedies (e.g., *J. dielsiana* Standl., *J. Schunke Vigo 1100*), similarly to some other members of tribe Cinchoneae (e.g., *Cinchona* L.).

Joosia was long diagnosed by its 5-merous flowers, its corollas with valvate lobes with marginal appendages, and its capsules with four twisted valves (e.g., Standley, 1936). However, Steyermark (1975) noted that the number of calyx lobes, corolla lobes, and anthers in *Joosia* actually varies from four to five, and he found this number consistent within many of the species, although he did not detail this feature in all the species he studied. Andersson (1997a) observed that flower merosity varies among flowers on an individual plant of several *Joosia* species and concluded that, therefore, it is never consistent within a species. In several *Joosia* species the two capsule valves do split longitudinally and then become spirally twisted as they dry after dehiscence, as characterized by Standley, but this feature is not

found in all *Joosia* species as noted by Standley himself (1936) as well as Steyermark (1975) and Andersson (1997a).

Joosia was first studied as a whole by Steyermark (1975), who separated the genus from other Cinchoneae by its corolla lobes with well-developed lobed marginal appendages. He reported the genus from Colombia, Ecuador, and Peru, recognized seven species, and presented a synoptic taxonomy with some morphological notes. Steyermark separated the species of *Joosia* in large part based on the size, form, and pubescence details of the calyx. He recognized two subgenera based on calyx form, with *Joosia* subg. *Joosia* diagnosed by a symmetrically lobed calyx and comprising most of the species, and *Joosia* subg. *Sectocalyx* Steyerm. distinguished by a spathaceous calyx and including only *J. dichotoma* (Ruiz & Pav.) H. Karst. He also circumscribed *J. umbellifera* as a widespread morphologically variable species with two subspecies and four varieties, and cited it as the type of the genus.

Subsequently, Andersson (1994) presented a floristic treatment of *Joosia* in Ecuador, and then a comprehensive review of the entire genus based on the numerous specimens made after Steyermark's study was published (1997a). Andersson (1997a) provided a detailed morphological overview of the genus, an updated taxonomy, and a phylogenetic hypothesis based on morphological characters, and he addressed several nomenclatural problems. Andersson found *Joosia* to be monophyletic and placed its ancestral habitat in lowland forest and its origin in the western Amazon basin. Andersson cited *J. umbellifera* as a newly designated lectotype for the genus, although Steyermark had previously studied both of the species Karsten originally included in *Joosia*, *J. umbellifera* and *J. dichotoma*, and had chosen (Steyermark, 1975: 252) this same species as the genus type. Andersson also noted that the plants that Steyermark included in his circumscription of *J. dichotoma* do not match the type of that name. To resolve this he proposed (Andersson, 1996) that the type of this name be changed to correspond to Steyermark's usage, and his proposed replacement type was formally conserved. Andersson also separated *J. dielsiana* and *J. pulcherrima* Steere, which had previously been synonymized by Steyermark and by him (Andersson, 1994). Andersson recognized *J. umbellifera* as a broadly circumscribed, morphologically very variable, widely distributed species with no infraspecific taxa, and synonymized several species with it. Andersson noted that one collection from Colombia (*S. Hoyos & J. J. Hernández 555*, MO) was unusual and perhaps a distinct species, but he included it provisionally in *J. umbellifera*. Andersson reported *Joosia* from Bolivia based only on the type of *Ladenbergia dichotoma* (Ruiz & Pav.) Klotzsch var. *calycina* Wedd., which he synonymized with *J. umbellifera*. In his analysis of the relationships among the species of *Joosia*, Andersson found *J. dichotoma* deeply nested within the genus and, consequently, did not separate *Joosia* subg. *Sectocalyx* (cited there as "Setocalyx"; Andersson, 1997a: 30).

The taxonomy of *Joosia* presented here is based on these previous works together with study of numerous specimens collected since Andersson's (1997a) work was published. This present taxonomy differs from each of the previous works in some details. In particular, *J. umbellifera* is circumscribed more narrowly here than by Steyermark (1975) and Andersson (1997a), although the supposedly aberrant specimen (*Hoyos & Hernández 555*) is here considered a good representative of this species. Several names that Andersson synonymized with *J. umbellifera* are recognized as distinct species here, in particular *J. panamensis* Dwyer and *J. ulei* Steyerm. *Joosia pulcherrima* is also circumscribed more narrowly here than by Steyermark (1975) and Andersson (1994), with *J. dielsiana* here separated from it as done by Andersson (1997a). Two names described in other genera are newly included here in *Joosia*, *Rondeletia loretensis* Standl. and *Ladenbergia sericea* Standl., and three new species are described here. In this revised taxonomy, the center of species diversity of *Joosia* still lies in the western Amazon basin and Andes of Ecuador and Peru, and *J. umbellifera* is still the most widely distributed species. Relationships among the species are not yet clear and will be studied later. Quite different sets of *Joosia* species are grouped by different characters. For example, flower merosity, corolla form, capsule shape, inflorescence arrangement, and geographic region or habitat each suggest different relationships. At present, it is not clear which characters are more reliable to indicate relationships, and it is hoped that molecular data will help with this.

Morphological Notes on *Joosia*

The morphology of *Joosia* was detailed by Andersson (1997a), and morphological characters discussed by him are not revisited unless more variation has been documented or they are interpreted differently here.

Many *Joosia* species have hirsute, hirtellous, strigose, sericeous, and/or weakly arachnoid pubescence, and in some species the young leaves are initially densely covered with a sericeous pubescence

that is rapidly caducous as the leaves expand (e.g., *J. antioquiana* C. M. Taylor, *J. confusa* C. M. Taylor). Pubescence characters were not used to distinguish species by Steyermark (1975) but were described briefly and used in some cases by Andersson (1997a). Variation is noted here in some species in the pubescence of the corollas, which often have the pubescence in two layers, one composed of short, stout, twisted trichomes and the other of longer, straight trichomes. Andersson described the corollas as "coarsely puberulous outside," i.e., with the trichomes very short and stout. However, the corollas of some *Joosia* species are externally puberulous and also strigose, with longer, slender, appressed trichomes, while the corollas of some other species are strigose but lack this shorter puberulous pubescence. Although raphides are absent, as noted by Andersson (1997a), the tissues have ample quantities of crystal sand, which is evident on many dried specimens.

The leaf secondary veins generally extend unbranched to unite with the leaf margins in *Joosia*, rather than reticulating a few millimeters short of the margins as in most Rubiaceae. The regularly spaced, subparallel tertiary venation is distinctive and has been described for *Joosia* as "lineolate" (Taylor, 2010, 2012). This is a general term in Rubiaceae and comprises several venation arrangements that differ in detail (e.g., tertiary vs. quaternary venation) but are similar in appearance to the naked eye; this venation is distinctive and an aid for identification. Andersson (1997a) reported that domatia have not been documented in *Joosia*, even though they are common in woody Rubiaceae including other genera of tribe Cinchoneae (Andersson, 1997b, 1998). However, this is no longer the case: a few specimens of two species do have scattered small pit-type domatia on the abaxial axils of the secondary veins (*J. umbellifera*, *López et al. 4048*; *J. panamensis*, *de Nevers et al. 6192*).

The stipules are interpetiolar, generally ligulate to elliptic, and held flattened and erect in bud. This stipule arrangement is characteristic of the genera of the tribe Cinchoneae and was cited by Andersson (1995) as a diagnostic character for this tribe. The stipules of *Joosia* are sparsely strigillose with deciduous trichomes to usually glabrous adaxially (i.e., internally), in contrast to the strigose or sericeous abaxial (outer) face. However, *Joosia* does have pubescence inside the stipule, in the form of a ring of pilose trichomes that is borne on the stem at the stipule insertion. These trichomes are straight, 1–2 mm, and dry whitened. They usually persist a little longer than the stipules, though they are ultimately deciduous; they are slender and do not appear to be glandular, but field observations will be needed to confirm this.

The inflorescences of *Joosia* are terminal, and, as usual in Rubiaceae, in some cases these are later displaced to pseudoaxillary by subsequent growth from one of the axillary buds at the node that produced the peduncle. However, in *Joosia*, frequently both axillary buds continue growing so the terminal position is retained.

Inflorescence arrangement in *Joosia* was analyzed in some detail by Andersson (1997a), who was the first to detail the characteristic monochasial form of the ultimate axes of many species. Steyermark separated several taxa based on the development of the peduncle and the number of "primary axes" (1975: 253–254), which in his usage corresponds to the secondary axes or sometimes to tertiary axes that are formed by the dichotomous branching at the basalmost branching node of the secondary axis. Most species of *Joosia* do not have a developed, clearly identifiable primary inflorescence axis. The primary and secondary axes are characteristically dichasial at their first branching node, with the axes above this node monochasial and sometimes markedly arched, cincinnoid, or secund. These upper axes continue to develop new buds apparently for some time, and not infrequently these upper axes are still producing new buds while fruits are developing on their lower nodes. Not infrequently, *Joosia* specimens bear buds, open flowers, and young and sometimes also mature fruits on the same axis (e.g., *J. dielsiana*, *Kayap 5*). In general, *Joosia* has inflorescences with the bracts reduced or few, small (0.3–1 mm), and irregularly distributed (e.g., Andersson, 1997a: 30–31). However, bracts are regularly developed on many plants of *J. panamensis*, and *J. frondosa* C. M. Taylor has well-developed bracts that are reported to be whitened and petaloid. The bracts of *J. frondosa* are similar in size and form to the calyx lobes, and the whitened bracts and calyx lobes together presumably produce a striking display on the inflorescence. However, the bracts of this species are not markedly enlarged in comparison to the calyx or stipitate as in the classic showbracts of *Neohymenopogon* Bennet and *Paederia* L. (Puff, 1991; *Blandibractea* Wernham has also been cited as having showbracts, but those structures were demonstrated to be calycophylls and this genus a synonym of *Simira* Aubl. by Delprete, 1998).

As noted by Andersson (1997a), the number of calyx lobes, corolla lobes, and anthers (i.e., flower merosity) varies on some individual *Joosia* plants and thus within a species, as in many Rubiaceae. However, 5-merous flowers are clearly predominant in some species, whereas in other species, all plants

consistently have 4-merous flowers, as noted by Steyermark (1975) for *J. ulei*. Thus, flower merosity does seem to characterize most if not all of the species.

Calyx limb size and form (i.e., degree of lobing and shape of the lobes) were considered diagnostic for most *Joosia* species by both Steyermark (1975) and Andersson (1997a), but this character can be problematic for species identification. This is because the calyx limbs fall off or disintegrate as the fruits develop, so the conclusive identification of fruiting plants is not always possible. Also, species with relatively larger calyx limbs seem to have more variation in overall length of this structure among different plants than species with shorter limbs, in percentage size variation as well as the actual size; calyx size overlaps between species. The degree of lobing seems to vary within some species, for example, from quite shallowly lobed to divided for up to two thirds of the length of the calyx limb in *J. aequatoria* Steyerm. and *J. umbellifera*. Andersson separated species of *Joosia* by whether the calyx limbs are lobed shallowly (i.e., for less than half their length) or deeply (i.e., for half or more of their length), but newer collections show that several species vary in this feature more than he noted. This is a useful feature found on most plants, so the key to *Joosia* species here again separates species based on the degree of lobing of the calyx limb, with species that are variable in this regard keyed under both conditions. *Joosia dichotoma* is unique in its spathaceous calyx limb, which is completely fused into a conical structure in bud and splits when the corolla elongates.

Most species of *Joosia* are documented by very few mature flowers, and only a few collections have field notes about flower color or whether the flowers are open during the day or night. Steyermark (1975) characterized several individual species of *Joosia* based on the position of their anthers (near the base of the corolla vs. in the upper part of its tube), but Andersson (1997a) clarified that *Joosia* species are distylous. Thus, these different anther positions in flowers of *Joosia* correspond to long-styled and short-styled flowers, respectively, rather than being a species-level difference. For nearly all the species of *Joosia*, insufficient flowering material is available to confirm that they are distylous and characterize each floral form.

In general, the corollas in *Joosia* range from green on the tube and pale green to white on the lobes, to bright deep pink throughout. This entire range of color variation is described for several species (e.g., *J. aequatoria*, *J. pulcherrima*), which probably deserve further study as to pollination mode. The corolla lobes of *Joosia* are distinctive in their marginal wings usually with elaborate appendages situated on each margin near the tip. One species, *J. antioquiana*, does appear to have marginal wings on the corolla lobes without additional appendages, and in some other species these appendages may be tardily deciduous on older flowers (e.g., *J. confusa*). These appendages are elliptic to suborbicular or flabelliform and characteristically 2–6 mm, and are usually themselves lobed and/or crisped (Andersson, 1997a: fig. 1G). These wings and appendages are inserted on the margins of the corolla lobes and folded inside the corolla in bud, and then unfold at anthesis presumably to increase the size and visibility of the corolla lobes. Similar structures are found in some other Rubiaceae genera of various tribes (Bremer & Eriksson, 2009), such as *Amphidasya* Standl. (Urophylleae), *Arachnothryx* Planch. (Guettardeae), and *Guettarda* L. (Guettardeae). Steyermark (1975: 251) described these corolla lobes as each having "two petaloid crispate appendages or wings attached to and thinner than the main body of the lobe," and referred to *Joosia*'s flowers as having bifid corolla lobes that he considered one of the diagnostic characters of the genus. Andersson (1997a) better detailed these appendages as well as the irregular fleshy marginal strip of the corolla lobes. He interpreted both the marginal strip and the appendages as parts of a marginal outgrowth and suggested that these outgrowths are folded inward in bud. Andersson (1997a: 25–27) suggested that due to the arrangement of the corolla lobes and their marginal appendages in bud, with the lobes valvate and the appendages folded inside, the corolla aestivation may be considered "involute rather than valvate." The term "involute" is somewhat inexact here, because the corolla lobes are still valvate in terms of having contact all along their margins. The arrangement in bud for each corolla lobe of *Joosia* can be described as involute sensu Gray (1887), but the term "involute" is not generally applied to aestivation by recent authors and the aestivation of *Joosia* does not match some uses of this term (e.g., it does not correspond to valvate-involute of Simpson, 2006: 371, fig. 9.2). The corolla aestivation of *Joosia* does match the valvate-induplicate arrangement of Robbrecht (1988: 82, fig. 29K) and this last term is preferred here.

Steyermark (1975) characterized and diagnosed *Joosia* based on its fruits splitting into four stiff-textured valves that become markedly twisted, and this character is found in many of the species. However, as Steyermark himself noted, not all plants of those

species have this feature, and some *Joosia* species consistently have two straight capsule valves. In the fruits with twisted valves, usually the pericarp is deciduous and the twisted structures are pieces of the endocarp. Neither Steyermark nor Andersson (1997a) used fruit size to characterize or diagnose *Joosia* species, but some species do have distinctive fruits. In particular, *J. dielsiana* has rather small, woody, ellipsoid fruits, and *J. aequatoria* has rather stout, somewhat short, obovoid or ellipsoid fruits. Seed size does vary among *Joosia* species (Andersson, 1997a), but mature seeds have not been documented from many of the species and the seeds vary notably in size within some species (e.g., *J. dielsiana*).

Habitat and Phytogeography of *Joosia*

Biogeographic characterization of *Joosia* is difficult due to the lack of detailed understanding of phytogeographic patterns and history in the Neotropics, and because the distributions of several species of *Joosia* do not correspond to any currently recognized phytogeographic regions.

Within Rubiaceae, *Joosia* belongs to the tribe Cinchoneae, a wholly Neotropical tribe (Andersson & Antonelli, 2005; Manns & Bremer, 2010). This tribe is distributed from southern Central America widely through the northern and central part of South America to Bolivia and southeastern Brazil. Within this region, all of the tribe's genera and the majority of its species are found in western South America, from lowland regions into the Andes. The relationships among the genera of Cinchoneae and their individual biogeographic histories are not yet known (C. Maldonado et al., in prep.), so it is difficult at present to postulate an area of origin for *Joosia* with confidence. Many or most of the species of the various genera of Cinchoneae are found in lowland regions, except those of *Pimentelia* Wedd. and *Stilpnophyllum* Hook. f., which are found at premontane and montane elevations and are apparently restricted to sandstone substrates. Most of the species of *Joosia* are found at lower elevations (i.e., below 1500 m), and the most widely distributed species as well as most morphological variation is found in wet areas at these lower elevations. Thus, an origin of *Joosia* in lowland western Amazonia as postulated by Andersson (1997a) is plausible based on niche conservatism, the present center of diversity, and the area with the probably older species (Paul et al., 2009).

Our understanding of the phytogeography of the Neotropics and the history of its plant distributions is at the beginning stages, especially for southern Central America, northern South America, and the Andes. Both botanical and geological exploration are actively underway in these regions; widely varied phytogeographic views of this region have been postulated, and a stable synthesis is not yet available. For example, for the tropical Americas Takhtajan (1986) recognized eight phytogeographic regions, while Andersson (1992) in his study of Rubiaceae phytogeography found 19 regions. More recently Sedio et al. (2013) studied Rubiaceae in southern Central America and northern South America and recognized five biogeographic regions. These were delimited differently from those of many previous authors and were based on phylogenetic reconstructions of selected groups together with recent geological views of this area. These regions cover the range of *Joosia* and seem the most useful for their biogeographic characterization, although additional phytogeographic detail may be needed in this scheme, in particular for the Andean region.

The regions recognized by Sedio et al. (2013) are Central America (from the Panama Canal in central Panama northward), Chocó-Darién (from the Panama Canal southward along the lowland Pacific slopes of Colombia and Ecuador and east along Caribbean Colombia, into the Río Magdalena valley), Andes (the Andean cordilleras at ca. 1500 m elevation and above), Venezuela (coastal Venezuela, including the Cordillera de la Costa, through central and eastern Venezuela including the Guayana Highlands), and the Amazon basin and eastern South America. The Amazon basin region undoubtedly deserves further detail and subdivision, but since *Joosia* is not found there, this region is not further analyzed here. The Andean region has been separated by some authors at the Huancabamba gap in northern Peru (e.g., Andersson, 1992), and this may be useful for Rubiaceae; however, central and southern Peru are very poorly known botanically, and ongoing exploration in central Peru has extended the range of many species southward. The Andean region has also been generally delimited as being above 1000 m (Andersson, 1992), but 1500 m may be a better lower limit (pers. obs.). In any case, the elevational patterns of individual species are different on the Pacific slopes of western Colombia and Ecuador, where rainfall is unusually high (pers. obs.), and on some sandstone mountains, where this substrate may produce different hydrological dynamics (Foster & Beltrán, 1997); therefore, the elevational limits of the Andean region may need to be locally adjusted. Neill et al. (2014) suggested separation of an additional phytogeographic region in western South America, the Andean tepuis. This region comprises scattered sandstone outcrops found in the Andes and isolated mountains in the western Amazon basin, which represent a distinct habitat with some apparently unusual

features. These Andean teupis have closer floristic affinities with each other and with the sandstone mountains of the Guayana Highlands than with their surrounding areas, and Foster and Beltrán (1997) also noted differing distribution patterns with much wider elevational ranges of individual species on these sandstone outcrops.

Only one *Joosia* species, *J. panamensis*, is found in the Central American region; however, this species is not limited to this region. Three species, *J. panamensis*, *J. umbellifera*, and *J. antioquiana*, are found in the Chocó-Darién region, with *J. panamensis* and *J. umbellifera* both found in other lowland regions; these last two species might also be considered to range into the Andean region depending on where its lower elevational limits are placed. *Joosia antioquiana* is only known from the lower Río Magdalena valley in northern Colombia, where several other Rubiaceae are apparently also endemic (e.g., *Ciliosemina purdieana* (Wedd.) Antonelli, *Coussarea antioquiana* C. M. Taylor), and thus is restricted to the Chocó-Darién region. Northern Colombia and this river basin in particular are not well known botanically, and these apparently endemic species may be more widely distributed than this; the pattern of endemism in this region does not seem to have been surveyed. However, *J. antioquiana* has often been found on sandstone substrates and may be restricted to these habitats, in which case this species might be better considered to be distributed in the Andean tepui region than the Chocó-Darién region.

Six species of *Joosia* are found in the Andean region, in Colombia, Ecuador, Peru, and Bolivia: *J. aequatoria* and *J. capitata* C. M. Taylor are both known only from 1900 m and above and thus restricted to this region, while *J. confusa*, *J. pulcherrima*, *J. standleyana* Steyerm., and *J. ulei* all range into lower elevations. The majority of the species of *Joosia* are found in the western part of the Amazon region, in Colombia, Ecuador, Peru, and Bolivia. Nine species are known only from these lower elevations, while the four species already noted range up to higher, Andean elevations. Three of these last species are at least sometimes found on sandstone outcrops at 1000 m and above and could be considered to be distributed in the Andean tepuis. Also *Joosia* is documented in Venezuela by plants that are not identified to species but are found at 1150–1250 m on a sandstone outcrop on the Andean Cordillera Oriental; these plants could be considered to be distributed in the Amazon region or the Andean tepui region. *Joosia umbellifera* is often found on quartzite substrates in the Amazon region; however, inadequate information is available to fully characterize its habitat.

This work is based on standard herbarium techniques. Additional specimen data and high-resolution scans of representative specimens of these species are available online in the TROPICOS® database and its Rubiaceae Project. The specimens studied here are all databased there and can be mapped interactively there. The species treated here are arranged in alphabetical order. Morphological terminology follows Lawrence (1951), Robbrecht (1988), and Taylor (2010). Comparative sizes mentioned in discussions refer only to other species of *Joosia*. Morphological measurements are based on dried specimens. Habitat and distribution are summarized for all the taxa treated here, but phenology is only summarized for taxa newly described. This article presents a taxonomy as preparation for the World Flora Online (<http://www.worldfloraonline.org>).

Joosia H. Karst., Fl. Columb. 1: 9, tab. 5. 1858. TYPE: *Joosia umbellifera* H. Karst. (lectotype, designated by Steyermark [1975: 252]).

Joosia subg. *Sectocalyx* Steyerm., Brittonia 27: 252. 1975. TYPE: *Cinchona dichotoma* Ruiz & Pav. [≡ *Joosia dichotoma* (Ruiz & Pav.) H. Karst.].

Joosia includes 18 Neotropical species of shrubs and small trees found in wet forest vegetation at 10–3000 m elevation, in Costa Rica, Panama, Colombia, western Venezuela, Ecuador, Peru, and northern Bolivia. Detailed morphological descriptions of *Joosia* were previously presented by Steyermark (1975: 252), Andersson (1994: 69; 1997a: 30–31), and Taylor (2012: 136).

Two species were originally included in *Joosia*, *J. umbellifera* and *J. dichotoma*, and the type of the genus was not originally designated. Steyermark (1975) recognized both of these species and explicitly cited *J. umbellifera* as the type of *Joosia* (1975: 252). Steyermark also noted that *Joosia* was described by Karsten based on a specimen collected in Colombia, which was named as *J. umbellifera*, and identified this specimen as the type of *Joosia*. Steyermark's explanation thus constitutes an explicit selection from among the syntype elements and constitutes an effective lectotypification; at the time Steyermark published, explicit use of the term "lectotype" was not required for an effective lectotypification (ICBN Art. 9.23; McNeill et al., 2012). Subsequently, Andersson (1997a) cited *J. umbellifera* as the lectotype of the genus with a statement that the lectotype was designated by him in that work, but Andersson's lectotype designation is superfluous.

KEY TO SPECIES OF *JOOSIA*

1. Calyx limb (i.e., free portion of the calyx above the ovary) spathaceous, fused in bud and splitting irregularly as the corolla grows; Peru ..... 5. *J. dichotoma* (Ruiz & Pav.) H. Karst.
1′. Calyx limb variously open in bud and subtruncate in flower to closed with pre-formed regular lobing and becoming symmetrically to somewhat irregularly lobed in flower; Costa Rica, Panama, Colombia, Venezuela, Ecuador, Peru, and Bolivia.
2. Calyx limb subtruncate to shallowly lobed, divided for less than half the length of the limb and with the tubular (unlobed) portion 1–6.5 mm long.
3. Stems, leaves, inflorescence axes, and ovary glabrous or ovary sometimes sparsely pubescent; calyx limb 7.5–9.5 mm long, shallowly lobed; Ecuador ..... 10. *J. macrocalyx* Standl. ex Steyerm.
3′. Stems, leaves, inflorescence axes, and ovary pubescent; calyx limb 1–8.5 mm long, subtruncate to lobed; Costa Rica, Panama, Colombia, Venezuela, Ecuador, Peru, and Bolivia.
4. Peduncles 3–11 cm long; flowers 5-merous; calyx limb (including lobes) 1–3.5 mm long; corolla tube 7–14 mm long.
5. Inflorescences with principal axes paired or 3- or 4-verticillate at basal node, in fruit the axes generally becoming elongated, rather straight, spiciform, and rather secund; apparently well-developed capsules 4–34 mm long, generally straight; Peru ..... 6. *J. dielsiana* Standl.
5′. Inflorescences with principal axes 3- to 9-verticillate at basal node, in fruit the axes short to elongated, flexuous, cincinnoid to weakly spiciform, secund or not; apparently well-developed capsules 40–100 mm long, straight to often curved; Colombia, Venezuela, Ecuador, and Peru ..... 18. *J. umbellifera* H. Karst. p.p.
4′. Peduncles 1–7 cm long; flowers 4- or 5-merous, or calyx limb sometimes irregularly 3-lobed; calyx limb 1.8–8.5 mm long; corolla tube 12–28 mm long.
6. Inflorescences branched to 1 to 3 orders, flowers mostly or all well separated on axes and pedicels.
7. Calyx limb 1.8–3 mm long; corolla tubes 12–17 mm long, 1–1.2 mm diam. near middle; capsules 2–3 mm diam ..... 4. *J. confusa* C. M. Taylor p.p.
7′. Calyx limb 3.3–6 mm long; corolla tubes 16–24 mm long, 3–3.5 mm diam. near middle; capsules 3–5 mm diam ..... 14. *J. pulcherrima* Steere
6′. Inflorescences subcapitate or fasciculate with axes not developed, flowers sessile to shortly pedicellate.
8. Flowers all sessile or subsessile, 5-merous; calyx limb 4–8 mm long; leaves abaxially with spreading-hirsute to hirtellous pubescence, with 13 to 17 pairs of secondary veins ..... 3. *J. capitata* C. M. Taylor
8′. Flowers sessile and/or shortly pedicellate, 4-merous; calyx limb 1.8–8.5 mm long; leaves abaxially with appressed-sericeous to strigose or hirsute to hirtellous pubescence, with 8 to 15 pairs of secondary veins.
9. Capsules obovoid and laterally somewhat flattened, 15–28 mm long, 5–7 mm diam. at widest part just below top ..... 1. *J. aequatoria* Steyerm. p.p.
9′. Capsules cylindrical, 20–52 mm long, 2–3 mm diam. along most of their length ..... 4. *J. confusa* C. M. Taylor p.p.
2′. Calyx limb deeply lobed, divided for half or more of the length of the limb and with the tubular (unlobed) portion 0.5–2 mm long.
10. Calyx limb 6.5–10.5 mm long, lobed nearly to base, with tubular (unlobed) portion 0.5–0.8 mm long, with lobes 6–10 mm long, lanceolate, acute; corollas unknown.
11. Inflorescences with peduncles 4–6 cm long and 6 to 18 flowers; leaves glabrous adaxially, 15–21 × 5.5–8.5 cm, with 12 to 17 pairs of secondary veins ..... 8. *J. longisepala* L. Andersson
11′. Inflorescences subsessile or with peduncle to 1.5 cm long and 1 to 6 flowers; leaves puberulous adaxially at least on veins, 6–21 × 2.5–6.5 cm, with 9 to 11 pairs of secondary veins..... 12. *J. oligantha* L. Andersson
10′. Calyx limb 1–10 mm long, lobed for 1/2 its length to deeply, with tubular (unlobed) portion 0.3–3 mm long, with lobes 0.5–8 mm long, triangular, deltate, lanceolate, ligulate, obovate, or elliptic, rounded to obtuse or weakly acute, when tubular portion less than 1 mm long then lobes 0.5–5.5 mm long, when lobes 6 mm long or longer then tubular portion 1–3 mm long; corolla tube 7–39 mm long.
12. Bracts well developed, elliptic to ligulate and 5–9 mm long ..... 7. *J. frondosa* C. M. Taylor
12′. Bracts reduced or triangular to ligulate or elliptic and up to 3.5 mm long.
13. Inflorescence subcapitate or axes generally all dichotomous and often short or with number of flowers reduced; calyx limb 3–8.5 mm long; corolla tube 9–29 mm long.
14. Calyx lobes triangular, 1–2 mm wide, obtuse to acute, generally erect in flower .... 1. *J. aequatoria* Steyerm. p.p.
14′. Calyx lobes ligulate to obovate or elliptic, 2–3.8 mm wide, obtuse to rounded, erect to spreading in flower.
15. Calyx limb (tube plus lobes) 3–4 mm long; leaves 2.5–15 × 0.5–5 cm; corolla tube 9–10 mm long; plants growing at 200–300 m ..... 11. *J. obtusa* L. Andersson
15′. Calyx limb (tube plus lobes) 4–6.5 mm long; leaves 5–17 × 2–6 cm; corolla tube 29–39 mm long; plants growing at 500–2600 m ..... 16. *J. standleyana* Steyerm.

13′. Inflorescence axes developed and dichasial, monochasial, or dichasial at basal nodes then with ultimate axes monochasial and multiflowered; calyx limb 1–7 mm long; corolla tube 7–18 mm long.
16. Leaves densely sericeous abaxially with some of the pubescence persistent and with 12 to 28 pairs of secondary veins; stipules 5–40 mm long; inflorescences rather congested, with axes mostly monochasial and reduced; corolla lobes with well-developed marginal wings but without elliptic or lobed appendages; northern Colombia ..... 2. *J. antioquiana* C. M. Taylor
16′. Leaves abaxially glabrous to strigillose, hirtellous, or sericeous with pubescence persistent to deciduous and with 8 to 20 pairs of secondary veins; stipules 10–21 mm long; inflorescences congested to lax, with axes dichasial to monochasial and generally developed; corolla lobes with elliptic to obovate marginal appendages; Costa Rica, Panama, Colombia, Venezuela, Ecuador, Peru, and Bolivia.
17. Inflorescences lax with principal axes 3- to 9-verticillate at basalmost node, becoming elongated and monochasial, 5–20 cm long, and generally all equally developed; calyx limb 1–2 mm long ..... 18. *J. umbellifera* H. Karst. p.p.
17′. Inflorescences congested to lax with principal axes paired or ternate at basalmost node, dichasial to monochasial, 2–8 cm long, and equally to unequally developed; calyx limb 1.5–7 mm long.
18. Flowers 4-merous.
19. Leaves with 9 to 11 pairs of secondary veins; 400–2000 m from central Ecuador to northern Peru ..... 17. *J. ulei* Steyerm.
19′. Leaves with 14 to 20 pairs of secondary veins; ca. 180 m in northern Peru or 500–1400 m in southern Peru and northern Bolivia.
20. Calyx lobes 2–3 mm long; ca. 180 m in northern Peru ..... 9. *J. loretensis* (Standl.) C. M. Taylor p.p.
20′. Calyx lobes 3–5.5 mm long, with at least some 3.1 mm long or longer; 500–1400 m in southern Peru and northern Bolivia ..... 15. *J. sericea* (Standl.) C. M. Taylor
18′. Flowers 5-merous.
21. Calyx lobes 0.5–1 mm long; Cordillera Oriental of western Venezuela ..... 19. *Joosia* sp.
21′. Calyx lobes 1.5–5 mm long; Costa Rica, Panama, Colombia, and Peru.
22. Inflorescence with branched portion ca. 4 cm long or longer; ca. 180 m in northern Peru .... 9. *J. loretensis* (Standl.) C. M. Taylor p.p.
22′. Inflorescence with branched portion 2–3 cm long; 10–1500 m in Costa Rica, Panama, and western Colombia .. 13. *J. panamensis* Dwyer

1. Joosia aequatoria Steyerm., Brittonia 27: 257. 1975. TYPE: Ecuador. Zamora-Chinchipe: Quebrada Achupallas, 9 Oct. 1943, *J. A. Steyermark 54506* (holotype, F-1179381 image!; isotypes, A [barcode] A00096622 image!, F-1179385 image!, US-1908632 image!).

Habitat and distribution. *Joosia aequatoria* is found in wet forest vegetation at 2010–3000 m in the Andes of southern Ecuador (El Oro, Loja, and Zamora-Chinchipe) and northern Peru (Cajamarca).

Notes. *Joosia aequatoria* is characterized by its inflorescences with 12 to 24 flowers; its floccose-hirtellous pubescence on the peduncle; its 4-merous flowers that are subsessile in one to five subcapitate to shortly dichasial groups; its rather well-developed calyx limbs 3.5–8.5 mm long with rather narrow triangular lobes; its greenish white to pink corollas that are obtuse to rounded in bud with tubes 18–28 mm at anthesis; and its rather woody, obovoid capsules that are 15–28 mm long and 5–7 mm in diameter at the widest point. Andersson (1997a: 38–39, fig. 1L) presented a description of *J. aequatoria* following the circumscription used here. He commented that additional specimens may show that this species is not distinct from *J. standleyana*, although he suggested that a more broadly circumscribed species including all of these plants would have an exceptional range of corolla size. *Joosia aequatoria* is better documented now and is clearly distinct in calyx and fruit characters from *J. standleyana*. However, these additional collections do show more variation in the form of the calyx limb, which is lobed for one third (e.g., *F. Prieto AP-15*, F, NY) to two thirds of its length; Andersson's characterization of this species as having the calyx limb lobed for more than half its length is no longer adequate to diagnose *J. aequatoria*. After anthesis the calyx limbs characteristically split along some or all the sinuses between the lobes, so the degree of lobing can be difficult to discern on these specimens. The corollas are reported to range from green on the tube and white on the lobes to pale green on the tube with pink lobes to deep pink throughout. Valencia Reyes et al. (2000) globally assessed this species as Endangered due to threats to its habitat, but it was subsequently found outside Ecuador. It was not re-evaluated by

León Yánez et al. (2011), and that first assessment is clearly no longer accurate.

Joosia aequatoria is similar to *J. pulcherrima*; *J. pulcherrima* can be separated by its calyx limbs that are lobed for less than one third of their length, its inflorescences with the flowers and fruits often separated on well-developed, dichasial to monochasial axes, and its cylindrical capsules 25–100 mm long and 3–5 mm in diameter. Also similar to these two species is *J. capitata*; *J. capitata* can be separated by its densely hirsute to hirtellous pubescence, its shallowly lobed calyx limbs, and its 5-merous flowers. *Joosia standleyana* is also similar to *J. aequatoria*, but *J. standleyana* can be recognized by its inflorescences with the flowers generally all separated on dichasial axes, its ligulate calyx lobes, its corolla tubes 29–39 mm long, and its cylindrical capsules. Some specimens of *J. aequatoria* were identified by Andersson (1994) as *J. dielsiana* (e.g., *F. Prieto AP-15*), apparently based on their calyx limbs that are lobed for less than half their length. However, *J. dielsiana*, as circumscribed by Andersson (1997a) and here, is not yet known from Ecuador and can be recognized by its calyx limbs 1–3.5 mm long, its corolla tubes 11–23 mm long, its capsules 2–4 mm in diameter, and its infructescences with the ultimate axes usually spiciform, straight, and elongated.

2. Joosia antioquiana C. M. Taylor, Novon 20(4): 475, fig. 2D, E. 2010. TYPE: Colombia. Antioquia: San Luis, Quebrada la Cristallina, 660–749 m, 8 Aug. 1985, *J. G. Ramírez, E. Rentería & O. Mesa 69* (holotype, JAUM image!; isotype, MO-05017430!).

Habitat and distribution. *Joosia antioquiana* is found in wet forest vegetation at 500–925 m in northwestern Colombia (Antioquia), at least sometimes on sandstone substrates.

Notes. *Joosia antioquiana* is characterized by its leaves with relatively numerous secondary veins; its often relatively large stipules; its cymose and usually congested inflorescences with markedly monochasial axes and 30 or more flowers; its rather short calyx limbs, ca. 2 mm long, that are lobed for about one half their length; its white corollas that are obtuse to rounded at the top in bud with tubes ca. 10 mm long at anthesis and lobes with the margins winged but without appendages; and its rather small, woody capsules 7–20 mm long. Several specimens of *J. antioquiana* are notable for the dense, finely sericeous, long (to 2 mm) trichomes of the leaves and stems, which are often twisted together and deciduous; this sericeous pubescence is found at least sparsely on all of the plants of this species but is usually quickly deciduous.

3. Joosia capitata C. M. Taylor, sp. nov. TYPE: Peru. Cajamarca: prov. San Ignacio, San José de Lourdes, Cerro Las Yeguas, 5°00′42″S, 78°54′29″W, 1900 m, 22 Jan. 2001, *R. Vásquez, R. Rojas, S. Flores & L. Campos 26457* (holotype, USM-193039!; isotypes, GB [barcode] GB-0119041!, MO-4873038!). Figure 1A, B.

Diagnosis. *Joosia capitata* C. M. Taylor is distinguished from *J. pulcherrima* Steere by its inflorescences with flowers sessile or subsessile in one head, its leaves abaxially with persistent, spreading, hirtellous to hirsute pubescence, and its usually more numerous secondary leaf veins.

Trees flowering at 10 m tall; stems with 2 layers of pubescence, the outer layer deciduous and hirtellous or strigillose, the shorter layer persistent and densely tomentulose. Leaves opposite; blades elliptic, 6–15 × 2–5 cm, at base acute to cuneate, at apex acute to acuminate with tips 3–5 mm, drying chartaceous to subcoriaceous, adaxially glabrous, abaxially densely strigose to pilosulous or hirsute on blade and densely pilosulous to hirtellous and also puberulous on costa; secondary veins 13 to 17 pairs, extending to unite weakly with margins, without domatia, adaxially costa sulcate and remaining venation plane, abaxially costa and secondary veins prominent and remaining venation prominulous; petioles 3–15 mm, densely hirtellous to strigillose and also with sparsely puberulous layer; stipules lanceolate, 7–9 mm, acute to obtuse at apex, abaxially densely strigose. Inflorescences capitate or subcapitate with 10 to 15 flowers in a single head, densely floccose and/or strigose to hirtellous; peduncle 1–4 cm; bracts triangular, 1–2 mm, acute. Flowers sessile to subsessile; hypanthium ellipsoid, 3–4 mm, densely hirsute; calyx limb densely strigose to hirsute, 4–7 mm, (4 to)5-lobed for 1/4–1/3 its length, lobes rounded to obtuse; corolla shape in bud unknown, at anthesis salverform to tubular-funnelform, white, externally densely strigose-sericeous, tube 15–25 mm, 2–3 mm diam. near middle, lobes 5, triangular, ca. 5 mm, with appendages ligulate, 3–4 mm, crisped to lobed; anthers and stigmas included, not seen. Capsules cylindrical, straight, ca. 34 × 5 mm; seeds not seen.

Habitat, distribution, and phenology. *Joosia capitata* is found in wet primary forest on clay soils at ca.

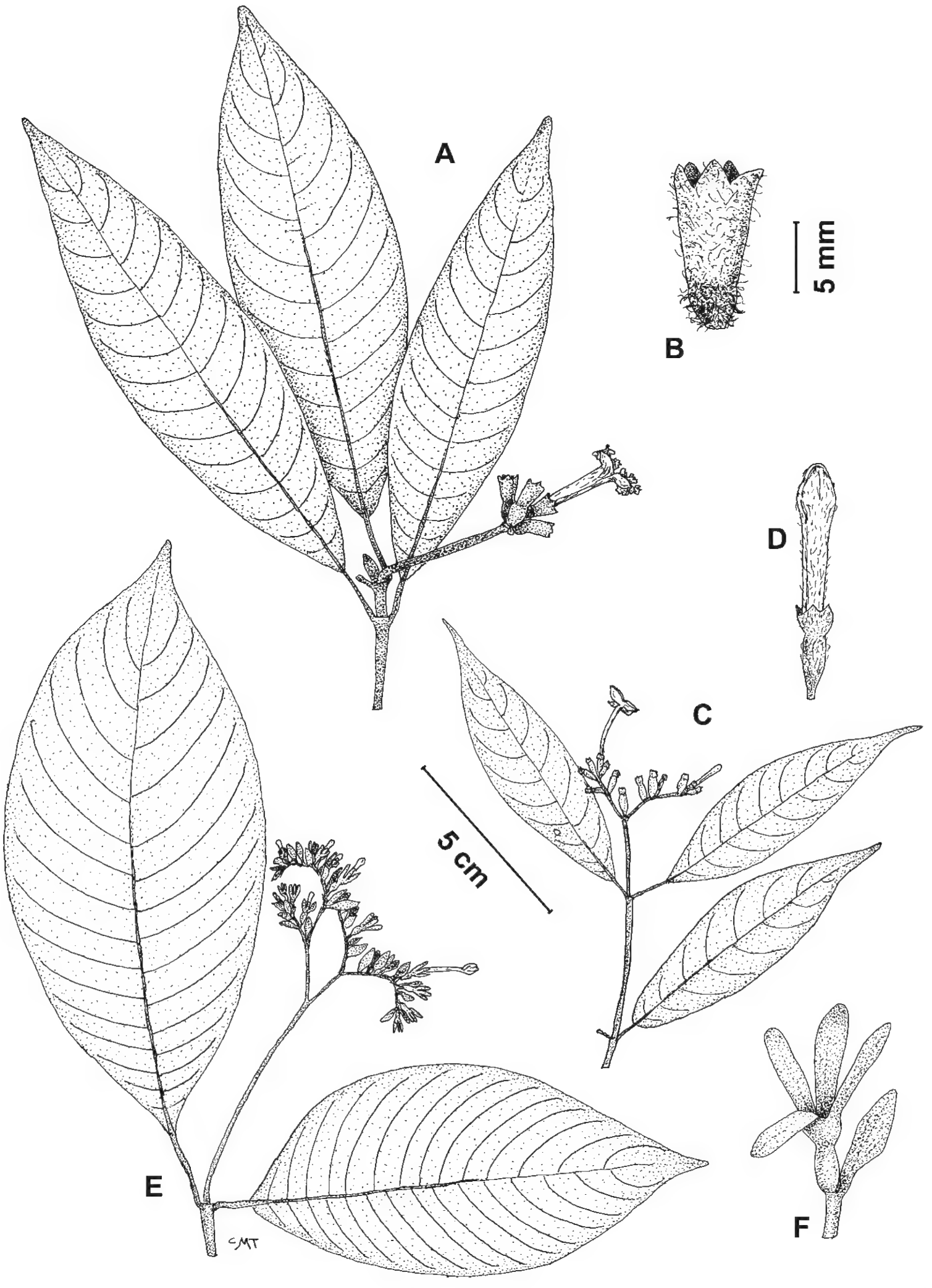

Figure 1. A, B. *Joosia capitata* C. M. Taylor. —A. Flowering branch. —B. Calyx (including hypanthium or ovary). C, D. *Joosia confusa* C. M. Taylor. —C. Flowering branch. —D. Flower bud. E, F. *Joosia frondosa* C. M. Taylor. —E. Flowering branch. —F. Portion of inflorescence with one bract and one flower from which corolla has fallen. Scale bars: A, C, E = 5 cm; B, D, F = 5 mm. A, B based on *Vásquez et al. 26457* (MO). C, D based on *Rimachi 4995* (MO). E, F based on *Sánchez et al. 3164* (COAH).

1900 m in northern Peru (Cajamarca); it has been collected with flowers and old fruits in January.

Notes. *Joosia capitata* is distinguished within *Joosia* by the combination of its densely hirtellous to hirsute pubescence on the stems and leaves; its capitate pedunculate inflorescences; its well-developed, shallowly lobed calyx limbs; and its white, rather robust corollas. An inflorescence with a single head is unusual in *Joosia*, and the species epithet refers to this arrangement. *Joosia capitata* is known from a single locality, in a zone that is rich in Rubiaceae species and rather poorly explored. Both collections of this new species have corollas, and these differ by ca. 30%–40% in size; this may represent the variation found in flower size in this species, or the smaller corollas may not have been fully developed when collected and then opened prematurely when dried. The pubescence of the leaf midribs, stems, and some peduncles is composed of different sizes and forms of trichomes, ± in layers: the lower or shorter layer has short, rather stout or twisted puberulous pubescence, while the upper layer has longer, generally straight, spreading to erect trichomes.

This new species is similar to *Joosia pulcherrima*, but *J. pulcherrima* can be separated by its leaves with moderate to sparse, appressed pubescence composed of generally only one form of trichomes; its cymose inflorescences that are branched to several orders and have the flowers mostly or all separated on well-developed axes or pedicels; and its 4-merous flowers. Inflorescences of a single pedunculate head are also sometimes found in *J. aequatoria*, but *J. aequatoria* can be separated from *J. capitata* by its moderate to sparse, appressed pubescence, its calyx limb that is lobed for one third to two thirds of its length, and its obovoid shorter capsules 15–28 mm long.

Paratype. PERU. **Cajamarca:** prov. San Ignacio, San José de Lourdes, Cerro Las Yeguas, *R. Vásquez, R. Rojas, S. Flores & L. Campos 26465* (GB, MO, USM).

4. Joosia confusa C. M. Taylor, sp. nov. TYPE: Peru. Huánuco: prov. Leoncio Prado, distr. Emileo Baldizan, carretera Tingo María–Pucallpa–La Divisora, ca. 1600 m, 22 Mar. 1980, *M. Rimachi Y. 4995* (holotype, USM-63673!; isotype, MO-4279717!). Figure 1C, D.

Diagnosis. *Joosia confusa* C. M. Taylor is distinguished from *J. ulei* Steyerm. by its calyx limbs that are lobed for less than half their length with the lobes triangular, acute, and erect in flower and by its more slender capsules 2–3 mm in diameter.

Shrubs or small trees, flowering at 2 m tall, to 6 m tall; stems densely arachnoid-sericeous or strigose to glabrescent. Leaves opposite; blades elliptic to narrowly elliptic or lanceolate, 5.5–13.5 × 1.2–5 cm, at base acute to obtuse, at apex acute to acuminate with tips 3–15 mm, drying chartaceous, adaxially densely floccose-sericeous to glabrescent, abaxially densely strigillose to strigose or sericeous on principal veins and sparsely sericeous or strigillose to glabrescent on lamina; secondary veins 8 to 12 pairs, extending to unite weakly with margins, without domatia, adaxially venation plane or costa prominulous, abaxially costa and secondary veins prominent and remaining venation plane to prominulous; petioles 5–15 mm, densely strigillose, strigose, or sericeous to glabrescent; stipules ligulate to ovate-ligulate, 4–16 mm, rounded at apex, abaxially sparsely to moderately sericeous. Inflorescences congested to laxly cymose with 5 to 25 flowers, densely sericeous or strigose to glabrescent; peduncles 2–6.5 cm; branched portion 2–9 × 4–22 cm, dichasially branched for up to 3 orders, with principal axes 2 or 3, paired or ternate, dichasially branched at base then sometimes becoming shortly monochasial and straight; bracts reduced or few, ca. 0.3 mm, and rounded. Flowers sessile or subsessile to pedicellate, pedicels to 7 mm; hypanthium narrowly ellipsoid, 3.5–4 mm, densely strigillose; calyx limb 1.8–3 mm, abaxially densely strigillose, 4-lobed for 1/4–1/3 its length, lobes triangular, acute, erect; corolla in bud obtuse at tip, at anthesis salverform, white, externally densely strigillose, tube 12–17 mm, ca. 1–1.2 mm diam. near middle, lobes 4, narrowly triangular, 4–4.5 mm, with appendages elliptic, 1.5–2 mm, lobed and/or crisped; anthers not seen; style ca. 5 mm, stigmas linear, ca. 2 mm. Capsules cylindrical, straight to curved, 40–50 × 2–3 mm; seeds not seen.

Habitat, distribution, and phenology. *Joosia confusa* is found in wet forests at 430–1800 m, at least sometimes on quartzite substrates, on the eastern Andean slopes and foothills of southern Ecuador (Zamora-Chinchipe) and northern to central Peru (Amazonas, Cajamarca, and Huánuco); it has been collected in flower in March and June, and with well-developed fruits in June, July, October, and December.

Notes. *Joosia confusa* is characterized by the combination of its rather slender habit, its silky floccose-sericeous pubescence, its congested-cymose to branched inflorescences with the axes dichasial to shortly monochasial, its 4-merous usually subsessile flowers, its shallowly lobed calyx limbs, its medium-

sized corollas, and its long, slender capsules. Only the type specimen has fully developed flowers, which have stigmas and styles similar to those of the short-styled form of distylous *Joosia* flowers. All of the specimens seen have the delicate floccose-sericeous pubescence on the young leaves that is characteristic of many species of *Joosia*; this pubescence is usually sparse and deciduous in *Joosia*, but it is well developed and often persistent in *J. confusa*.

All of the specimens seen of *Joosia confusa* were collected after the publication of Steyermark's work (1975). The plants included here in *J. confusa* were included in the circumscription of *J. pulcherrima* by Andersson (1997a), but with more material now available these species are clearly separable. *Joosia pulcherrima* can be distinguished from *J. confusa* by its flowers that are usually separated on developed axes, its larger corollas with tubes 16–24 mm long and 3–5 mm in diameter, and its stouter (3–5 mm in diameter) capsules. Specimens of *J. confusa* have also been confused with *J. ulei* and *J. umbellifera*, before it was recognized as a distinct species; the specific epithet refers to its problematic past. *Joosia confusa* is indeed similar to *J. ulei* (which Andersson [1997a] included within the circumscription of *J. umbellifera*), but *J. ulei* can be separated from *J. confusa* by its calyx limbs that are deeply divided into obtuse to rounded, usually spreading lobes and its stouter (4–5 mm in diameter) capsules. *Joosia confusa* is also similar to reduced plants of *J. umbellifera*; however, *J. umbellifera* can be recognized by its leaves with usually more numerous secondary veins, 12 to 16 pairs, its more robust inflorescences with several well-developed, cincinnoid to spiciform axes, its 5-merous flowers, and its usually shorter (1–2 mm long) calyx limbs.

Paratypes. ECUADOR. **Zamora-Chinchipe:** cantón Nangaritza, sector Pachicutza, sendero hacia El Hito, *J. Jaramillo & E. Grijalva 13372* (MO, QCA n.v.), *J. Jaramillo 14066* (GB, NY); Miazi, detrás camp. militar, *W. Palacios, I. Vargas, C. Galarza & J. Romero 8581* (MO, QCNE n.v.); región Cordillera del Cóndor, lado O río Nangaritza, por carretera 14 km al S de Guayzimi, *W. Quizhpe, S. Churchill & E. Jaramillo 1812* (LOJA n.v., MO); cantón Yacuambi, centro Shuar Kurints, Cordillera Kunku Naint (Cordillera de la Ciudad), Reserva Tukupi Nunke, *A. Wisum & C. Kajekai 783* (LOJA n.v., MO). PERU. **Amazonas:** prov. Condorcanqui, Cordillera del Cóndor, Puesto de Vigilancia Alfonso Ugarte (PV3), cabeceras río Comainas, tributario O del río Cenepa, cuchillo al N camp., *H. Beltrán & R. Foster 836* (F n.v., MO, USM); prov. Bagua, distr. Imaza, Tayu Mujaji, comun. Wawas, *R. Rojas, A. Pena, J. Anag & E. Yagkuag 427* (GB, MO, USM), *444* (GB, MO); quebrada El Almendro, *H. van der Werff, B. Gray, R. Vásquez & R. Rojas 14579* (GB, MO, USM). **Cajamarca:** prov. San Ignacio, San José de Lourdes, base Cerro El Parco, *R. Vásquez, J. Campos, G. Calatayud, M. Huamán & B. Cordova 26639* (GB, MO). **Huánuco:** La Divisora, betw. Tingo María & Aguaytia, Cordillera Azul, *A. Gentry, D. Smith & N. Jaramillo 41457* (GB, MO, USM); prov. Leoncio Prado, distr. Hermilio Valdizan, ca. La Divisora, *J. Schunke Vigo 9359* (F, MO, NY-2 sheets), *9361* (F, MO, NY-2 sheets, USM).

5. Joosia dichotoma (Ruiz & Pav.) H. Karst., Fl. Columb. 1: 9, tab. 5. 1858. *Cinchona dichotoma* Ruiz & Pav., Fl. Peruv. 2: 53, tab. 197. 1799. *Cosmibuena dichotoma* (Ruiz & Pav.) G. Don, Gen. Hist. 3: 479. 1834. *Ladenbergia dichotoma* (Ruiz & Pav.) Klotzsch in Hayne, Getreue Darstell. Gew. 14(2): sub tab. 15. 1846. *Ladenbergia dichotoma* var. *klotzschiana* Wedd., Hist. Nat. Quinquinas 92, tab. 26. 1849, nom. inval. TYPE: Peru. Huánuco: prov. Huamalias, Quebrada Maquizapa on rd. Monzón, 782 m, 20 Feb. 1966, *J. Schunke Vigo 1100* (typ. cons., NY [barcode] NY 2361495!; isotypes, F-182725!, F-1836355!, MO-239672!, MO-2815862!, NY [barcode] NY 2361496!, VEN n.v.).

Habitat and distribution. *Joosia dichotoma* is found in wet forests at 275–950 m in northern to central Peru (Amazonas, Huánuco, Loreto, Pasco, and San Martín) and is rather frequently collected.

Notes. *Joosia dichotoma* is distinguished within *Joosia* by its well-developed spathaceous calyx limbs (Andersson, 1997a: fig. 1D), which are unique in this genus. It is additionally characterized by its inflorescences with about six to 30 flowers borne on regularly dichotomous axes, its corolla tubes 11–17 mm long, and its capsules that vary markedly in size (10–60 mm long). Descriptions of this species in the circumscription adopted here were presented by Steyermark (1975: 9259–9262) and Andersson (1997a: 35–36). *Joosia dichotoma* varies from usually glabrous to occasionally hirsute or villous (e.g., *J. Schunke Vigo 6561*, MO), and as noted by Andersson there are no other evident differences between glabrous and pubescent plants; the pubescent form is much less common. Both Steyermark (1975) and Andersson (1997a) sometimes cited the authorship of this species incorrectly as only "Ruiz & Pav." The data on the type specimen *J. Schunke Vigo 1100* report that the species is used medicinally to treat malaria.

The name *Cinchona dichotoma* was based on a specimen collected by Juan José Tafalla, who collected plants for Ruiz and Pavón, at Pueblo Nuevo near Chicoplaya in the Monzón River valley in Huánuco, Peru. The name *C. dichotoma* was long used for a *Joosia* species found in Amazonian Peru

that was characterized by a glabrous capsule reaching 65 mm in length with the valves becoming twisted, a dichotomously branching inflorescence, leaves that are strigose on the adaxial surface, and a short, regularly lobed calyx limb (Standley, 1936). Ruiz and Pavón's type specimen of *C. dichotoma* is in fruit, with most of the fruits lacking a calyx limb and the others having a short, regularly lobed calyx limb (G-DC in photo, F neg. #6641 at MO-1694223). Steyermark (1975) concluded that this specimen matched plants with spathaceous calyx limbs, and that the short, lobed calyx limbs that remain on this specimen and are illustrated in the protologue figure are fragmentary remnants of a larger, entire structure. Steyermark noted that he determined the identity of Ruiz and Pavón's specimen and the name *C. dichotoma* primarily based on other *Joosia* collections that he considered to come from the same region as Tafalla's specimen (Steyermark, 1975: 261). In particular, he considered *J. Schunke Vigo 1100* as a topotype and representative of *C. dichotoma*, and he based his description and identifications of *J. dichotoma* on this collection. This collection has well-developed spathaceous calyx limbs, which indicate indisputably its identity. Steyermark's application of the name *C. dichotoma* thus differed from Standley (1936), who cited as a representative specimen of *J. dichotoma* the collection *E. Ule 6795*, which Steyermark separated as the type of *J. ulei*. Andersson (1996, 1997a) also noted that the calyx limbs that remain on the type specimen of *C. dichotoma* are not fragmentary remnants but intact calyx limbs. He showed (Andersson, 1996) that although floral features are not well preserved on Ruiz & Pavón's specimen, its regularly lobed, rather short calyx limbs together with its well-developed cincinnoid to spiciform inflorescence axes and well-developed cylindrical capsules show that this specimen represents *J. umbellifera*. His conclusion agrees with the plant illustrated as *Ladenbergia dichotoma* by Weddell (1849: tab. 26). However, even though Steyermark used the name *C. dichotoma* for a different species than other authors, his was the primary reference treatment for *Joosia* for several decades. Therefore, to preserve the existing usage of these names, Andersson (1996) proposed that the specimen *J. Schunke Vigo 1100*, cited as representative by Steyermark (1975), be conserved as the type of *C. dichotoma*, and his proposal was adopted in the Tokyo Congress. This conserved type collection represents the glabrous form of this species.

The collection data cited here for *J. Schunke Vigo 1100* are compiled from the labels of two sets of specimens with this number. These sets have labels of two different forms, with partially different and complementary information. *J. Schunke Vigo 1100* has several duplicates distributed at several institutions, and most of these are in good condition and clearly show the identity of the plant. Andersson (1996) designated as the conserved type of *Cinchona dichotoma* the duplicate specimen of *J. Schunke Vigo 1100* that he identified as the specimen deposited at NY and cited by Steyermark. There are actually two duplicates of *J. Schunke Vigo 1100* deposited at NY, but only one of these has been annotated by both Steyermark and Andersson as *Joosia dichotoma*; the other duplicate has been identified until now only as *Joosia* sp. and was not annotated by either of them. Thus, the single specimen that was annotated by Steyermark must be considered the conserved type designated by Andersson. This specimen is in mature fruit, but unfortunately the calyx limbs have all fallen off the fruits, so the diagnostic spathaceous calyx of this species is represented on this particular specimen only by a few calyx fragments in the loose material in the specimen's packet. The other duplicate of this collection deposited at NY has flowers, and this other duplicate as well as the duplicates of *J. Schunke Vigo 1100* deposited at other institutions all have spathaceous calyces in good condition; the identity of the plant represented by this collection is clear.

Weddell recognized two varieties of *Ladenbergia dichotoma*, *L. dichotoma* var. *klotzschiana* and *L. dichotoma* var. *calycina*, and he included all the plants of this species in these two varieties. His *L. dichotoma* var. *klotzschiana* included the Tafalla collection that Ruiz and Pavón named as *Cinchona dichotoma*, and thus as noted by Andersson (1997a) this name corresponds to the typical variety of this species. Thus, this varietal name is not validly published because the typical variety is autonymic and thus correctly should be called *L. dichotoma* var. *dichotoma* (and this variety is now typified by the conserved type of *C. dichotoma*). Weddell's variety *L. dichotoma* var. *calycina* was based on one plant, and although Weddell gave the distribution of the species *L. dichotoma* as being entirely in Peru, he also reported that the type specimen of this second variety was collected in Bolivia. The type specimen of *L. dichotoma* var. *calycina* has only mature and old capsules, with no calyx limbs remaining attached. This type specimen is provisionally included here in *J. sericea* based on its similar general aspect and *J. sericea* being the only species of this genus documented from Bolivia. No characters of this specimen conflict with characters of *J. sericea*, but this is not a conclusive identification.

6. Joosia dielsiana Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 11(5): 219. 1936. TYPE: Peru. Amazonas: upper [Río] Marañón, mouth of Río Santiago, 160 m, 5 Nov. 1924, *G. Tessmann 4478* (holotype, B†; lectotype, designated by Andersson [1994: 72], NY [barcode] NY00132043!; isolectotype, F-654355 image!).

Habitat and distribution. *Joosia dielsiana* is found in wet forest vegetation at 180–610 m in northern Peru (Amazonas and Cajamarca), and although the range appears rather restricted, this species has been quite frequently collected here.

Notes. *Joosia dielsiana* is characterized by its inflorescences with 15 to 50 flowers, the axes becoming monochasial and spiciform, and the fruits often finally secund; its calyx limbs 1.5–3.5 mm long that are lobed for less than one fourth of their length; its white corollas that are obtuse to rounded at the tip in bud and at anthesis have tubes 11–12 mm long; and its rather stout, woody, generally straight capsules 4–34 mm long. The inflorescences characteristically are initially short with the axes markedly cincinnoid and the flowers closely set, then as flowering proceeds the axes elongate markedly and the fruits also begin to develop on the lower part of the inflorescence. The axes eventually become monochasial to spiciform with the pedicels or nodes well separated along them, and the capsules often take on a secund arrangement. The young inflorescences are so different in size, arrangement, and form from the well-developed older inflorescences and infructescences that plants with young inflorescences can be difficult to associate with confidence with mature fruiting plants.

Steyermark (1975) and Andersson (1994) circumscribed *Joosia dielsiana* to include *J. pulcherrima*, which also has congested young inflorescences and shallowly lobed calyx limbs, but Andersson (1997a) later separated these two species and clarified their distinctions. Andersson (1997a: 34–35, fig. 1A) presented a description and illustration of these two species in the circumscription adopted here. *Joosia pulcherrima* differs from *J. dielsiana* in its inflorescences with the axes regularly branched or only shortly monochasial, its longer calyx limbs 3.5–8.5 mm long, its green to white or pink corollas with tubes 16–24 mm long, and its capsules 25–100 mm long.

One fruiting collection from southern Peru (Dept. Cuzco, Prov. Cuzco, Distr. Camisea, camp. Segakiato, 5 km downriver from commun. Segakiato, SI-MAB Plot Segakiato, 11°48′18″S, 72°52′30″W, 1400 m, *P. Acevedo-Rodríguez, P. Núñez, F. Ramírez & J. Tentello 10067*, MO, NY, US) agrees with *Joosia dielsiana* in its vegetative features, infructescences with the axes well developed and spiciform, relatively short capsules, and calyx limbs of similar size to *J. dielsiana*. However, its calyx limbs are lobed more deeply, for about one half their length, and this collection locality is far from the documented range of *J. dielsiana*. This plant may represent a southern range extension and additional variation in calyx form for *J. dielsiana*, but it cannot be identified further from the specimens available.

7. Joosia frondosa C. M. Taylor, sp. nov. TYPE: Colombia. Cauca: mpio. Santa Rosa, aguas arriba desembocadura del Indiyaco en el Caquetá, 380 m, 17 Oct. 1996, *R. Sánchez, A. Espitia, C. Moreno & P. Torrijos 3164* (holotype, COAH-032779!; isotype, COL-428662!). Figure 1E, F.

Diagnosis. *Joosia frondosa* C. M. Taylor is distinguished from other species of *Joosia* by its larger, ligulate to narrowly elliptic, obtuse to rounded bracts and calyx lobes.

Shrubs flowering at 2 m tall, to 4 m tall; stems glabrous. Leaves opposite; blades elliptic to obovate, 9–19.5 × 3.5–9 cm, at base cuneate to obtuse, at apex acuminate with tips 8–15 mm, drying papyraceous, adaxially glabrous, abaxially densely strigillose on costa and veins and glabrous on lamina; secondary veins 14 to 19 pairs, extending to parallel then unite weakly with margins, without domatia, adaxially costa and secondary veins prominulous and remaining venation plane, abaxially costa prominent, secondary veins prominulous to prominent, and remaining venation prominulous; petioles 5–32 mm, glabrous to sparsely strigillose; stipules lanceolate to ligulate, 21–27 mm, obtuse to rounded at apex, abaxially glabrous. Inflorescences cymose with 15 to 50 flowers, glabrous; peduncle 4–7.5 cm; branched portion 7 × 9–10 cm, dichasially branched to 3 orders, with principal axes 3 or 4, paired or ternate, dichasial at base then prolonged and monochasial, often cincinnoid at tips; bracts ligulate to narrowly elliptic, 5–9 mm, obtuse to rounded, green to whitened. Flowers sessile or subsessile; hypanthium narrowly ellipsoid, ca. 3 mm, glabrous; calyx limb glabrous, deeply 4-lobed, with tubular (i.e., unlobed) basal portion 1–1.2 mm, lobes narrowly elliptic to ligulate, 3–8 mm, unequal in length by 20%–30% on an individual flower, obtuse to rounded, erect in flower then spreading with age, green to whitened; corolla in bud obtuse to rounded at tip, apparently

salverform, white, externally moderately to densely strigillose, tube to 14 mm, to 1 mm diam. near middle, lobes 4, elliptic, to 3 mm, reportedly appendaged but appendages not seen; anthers and stigmas not seen. Capsules and seeds not seen.

Habitat, distribution, and phenology. *Joosia frondosa* is found in wet, at least sometimes disturbed forest at 100–800 m in the eastern Andean foothills of southwestern Colombia (Cauca and Putumayo); it has been collected with flowers August through October.

Notes. *Joosia frondosa* is distinguished in this genus by its well-developed bracts and calyx limbs, which apparently are somewhat petaloid; the specific epithet refers to these structures. *Joosia frondosa* is known from a small area, but this is part of a region that is not well known botanically.

This new species is similar in general aspect to some species of *Arachnothryx* with well-developed whitened bracts and calyx limbs and salverform white corollas of similar size, in particular *A. spectabilis* (Steyerm.) Rova, Delprete & B. Bremer and *A. bertieroides* (Standl.) Borhidi. The *Arachnothryx* species can be recognized by their persistent stipules and corolla lobes that are imbricate in bud and subglobose capsules 4–7 mm long. *Joosia frondosa* is also similar in aspect and in its well-developed bracts to *Psychotria capitata* Ruiz & Pav. (tribe Palicoureeae), but *P. capitata* can be separated by its stipules that are bilobed for one third or more of their length, 5-merous flowers, valvate corolla lobes, and succulent drupaceous fruits.

Paratypes. COLOMBIA. **Putumayo:** Serranía de Churumbelo, sector entre la bocana del río Ponchayaco hasta las cabeceras en la vereda Bajo Afá, *D. Cárdenas, C. Marín, C. Guerrero, S. Guerrero & H. Guerrero 13329* (COAH); along Río Putumayo, above confluence with Río Mocoa, *D. D. Soejarto, H. Vogelmann, E. Olday & E. Hernánez 1245* (COL).

8. Joosia longisepala L. Andersson, Brittonia 49: 37. 1997. TYPE: Ecuador. Pastaza: Puyo, Pambayacua, Río Lliquino, 1°29′S, 77°22′W, 420 m, 7–10 May 1992, *W. Palacios 10145* (holotype, MO-04633957!; isotypes, GB [barcode] GB-0048568 image!, QCNE-68018 image!).

Habitat and distribution. *Joosia longisepala* is found in wet forests at 400–500 m in east-central Ecuador (Pastaza).

Notes. *Joosia longisepala* can be recognized by its rather robust stems, leaves, and inflorescence axes (for *Joosia*) that are sericeous to hirsute at least when young; its leaves with relatively numerous (12 to 17 pairs) secondary veins; its inflorescences with regularly dichasial axes; and its well-developed calyx limbs that are deeply divided into acute triangular lobes 6–10 mm long. The densely sericeous to hirsute pubescence of the young growth is often persistent, but it is sometimes deciduous with age, similarly to most species of *Joosia*. This poorly known species is known from a rather small range in a general region that is poorly known botanically, and its mature corollas and fruits are not yet documented. The conservation status of *J. longisepala* was assessed as Vulnerable due to a small population size by León Yánez et al. (2011), but its range is now larger with the discovery of a new subpopulation (*Gudiño 340*) so this assessment is no longer valid.

9. Joosia loretensis (Standl.) C. M. Taylor, comb. nov. Basionym: *Rondeletia loretensis* Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 16(6): 61. 1936. TYPE: Peru. Loreto: Florida, Río Putumayo, at mouth of Río Zubineta, 180 m, May–July 1931, *G. Klug 2151* (holotype, F-668754 image!; isotypes, MO-1039452!, NY [barcode] NY00133187 image!, US-1456798 image!).

Shrubs flowering at 1.5 m tall; stems densely strigose. Leaves opposite; blades oblanceolate to obovate, 12–19 × 4–6 cm, at base acute, at apex acuminate with tips 10–15 mm, drying papyraceous to chartaceous, adaxially when young sericeous with deciduous trichomes and otherwise glabrous or sometimes strigillose on costa, abaxially densely strigose on costa and secondary veins, strigillose to sericeous on tertiary venation with pubescence oriented at 90° to veins, and glabrescent on lamina; secondary veins 16 to 17 pairs, extending to unite weakly with margins, without domatia, adaxially venation plane or costa prominulous, abaxially costa and secondary veins prominent, tertiary venation prominulous, and remaining venation plane; petioles 10–15 mm, densely strigose; stipules ligulate, ca. 10 mm, obtuse at apex, abaxially densely strigose becoming glabrescent. Inflorescences cymose with ca. 20 flowers, densely strigose-sericeous; peduncle 4–5 cm; branched portion ca. 4 × 6 cm, dichasially branched to 1 or 2 orders, with principal axes 2 or 3, paired, at basal node dichasial and then monochasial in upper part, arched to straight; bracts narrowly triangular, 1.5–3 mm, acute. Flowers sessile or subsessile; hypanthium cylindrical, ca. 2.5 mm, densely strigose and also densely hirtellous; calyx limb 2.3–3.3 mm, moderately to sparsely strigillose and also sparsely puberulous, (4 to)5-lobed nearly to

base, lobes triangular or lanceolate, acute; corolla in bud obtuse at tip, externally densely strigose and also puberulous, tube to ca. 10 mm, to ca. 1.5 mm diam., lobes to ca. 3 mm; anthers and stigmas not seen. Capsules and seeds not seen.

Habitat and distribution. *Joosia loretensis* is found in wet forest vegetation at ca. 180 m in northern Peru (Loreto).

Notes. *Joosia loretensis* is characterized by its pedunculate inflorescences with about 20 flowers and the axes cincinnoid when young then elongated and monochasial when older; its rather well-developed, deeply lobed calyx limbs with triangular to lanceolate lobes 2–3 mm long; and its white corollas that are obtuse in bud with tubes ca. 10 mm long. It is known only from the type collection, which has inflorescences with the flowers all in bud and very young fruits from which the corollas have fallen. *Joosia loretensis* does resemble species of *Rondeletia* L. and *Arachnothryx* in general aspect, as noted by Standley when he described this species, but has the lineolate tertiary leaf venation and ligulate stipules that are held erect and pressed together in bud that distinguish *Joosia*.

The identity of this species is not entirely clear, but its type does not match any other *Joosia* species. *Joosia loretensis* is generally similar to *J. sericea*, which is also poorly known. As discussed in the introduction, these were included by Andersson (1997a and in sched.) in his circumscription of *J. umbellifera* (even though *J. loretensis* and *J. sericea* have calyx limbs that are deeply lobed) while he diagnosed *J. umbellifera* in part by its shallowly lobed calyx limbs. *Joosia sericea* differs from *J. loretensis* in its generally longer calyx limbs with lobes 3–5.5 mm long; these species are apparently geographically separated with *J. sericea* found at 500–1400 m in southern Peru and northern Bolivia. Their relationship cannot be evaluated further until both of these species are better documented.

10. Joosia macrocalyx Standl. ex Steyerm., Brittonia 27: 259. 1975. TYPE: Ecuador. Napo: Archidona-Tena region, ridge S of Rio Pano, Cordillera de Guacamayos, W of Tena, 5300 ft, 25 Mar. 1944, *M. Ownbey 2739* (holotype, F-1150275 image!; isotypes, MO-1600858!, NY [barcode] NY-00132044 image!, US-2165981 image!).

Habitat and distribution. *Joosia macrocalyx* is found in wet forests at 850–1600 m in east-central Ecuador (Napo and Zamora-Chinchipe).

Notes. *Joosia macrocalyx* can be recognized by its glabrous stems, leaves, and inflorescence axes; its glabrous to sparsely strigillose calyx limbs and ovaries with the calyx limbs rather well developed, tubular, shortly lobed, and 7.5–9.5 mm long (Andersson, 1997a: fig. 1C); its corolla tubes 12–16 mm long; and its cylindrical rather than fusiform or obovoid fruits. The inflorescences have about 10 to 20 flowers with the axes shortly monochasial. Descriptions of this species in the circumscription adopted here were presented by Steyermark (1975: 259) and Andersson (1997a: 35, fig. 1C). Valencia Reyes et al. (2000) assessed the conservation status of this species as Vulnerable due to its small population size, but based on the same information, León Yánez et al. (2011) later considered it Critically Endangered due to its small range and threatened habitat.

11. Joosia obtusa L. Andersson, Brittonia 49(1): 37, fig. 1G, I. 1997. TYPE: Ecuador. Morona-Santiago: Río Pangui ca. 10 km SSE military camp at Taisha, 2°25′S, 77°28′W, 250–300 m, 20 June 1980, *J. S. Brandbyge & E. Azanza C. 32109* (holotype, AAU!; isotypes, GB [barcode] GB-0048568 image!, MO-4909607!, NY [barcode] NY00074082 image!, QCA [barcode] QCA95195 image!).

Habitat and distribution. *Joosia obtusa* is found in wet forests at 200–420 m in the Cordillera Cutucú and the Cordillera del Cóndor in eastern Ecuador (Morona-Santiago), perhaps on sandstone substrates, but this has not been noted in collection data.

Notes. *Joosia obtusa* is characterized by its pedunculate inflorescences with 10 to 20 flowers and the principal axes becoming monochasial as the fruits develop; its 4-merous flowers; its deeply divided calyx limbs with the lobes 2–3 mm long and obtuse to rounded; its white or pale green corollas with the tubes 9–10 mm long; and its slender, often curved capsules 15–53 mm long. In the protologue of this species, Andersson (1997a) reported the locality of the type collection variously as "250–300 m" (p. 37) and "200–300 m" (p. 38); the specimen label carries the first elevation range. *Joosia obtusa* is documented from a rather limited geographical and elevational range in a region that is not well known botanically. Two specimens here included in *J. obtusa*, *E. Freire & J. Cerda 190* (MO, NY) and *W. H. Camp E s.n.* (NY, US), were included by Andersson (1997a: p. 34 and in sched.) in *J. umbellifera*, but these collections are here included in *J. obtusa*. *Joosia obtusa* was assessed as Near

Threatened by Valencia Reyes et al. (2000), but based on the same information, León Yánez et al. (2011) later considered it Critically Endangered due to its small range and threatened habitat.

12. Joosia oligantha L. Andersson, Fl. Ecuador 50: 76, fig. 10C, D. 1994. TYPE: Ecuador. Pastaza: Mera, 1100 m, 19 Mar. 1956, *E. Asplund 20011* (holotype, S-R-7500 image!; isotype, S12-16606 image!).

Habitat and distribution. *Joosia oligantha* is found in wet forests at 900–1500 m at scattered localities on the eastern slopes of the Andes from northern to southern Ecuador (Napo, Pastaza, Sucumbíos, and Zamora-Chinchipe).

Notes. *Joosia oligantha* is characterized by its rather slender habit, its inflorescences with one to 12 flowers that are solitary or fasciculate, its 4-merous flowers, its deeply divided calyx limb with the lobes ca. 9.5 mm long, and its slender capsules 67–100 mm long. The corollas of this species have not been seen. The flowers are described as white in the notes on *T. Croat 97165* (MO), but that specimen has no flowers now, so flowers may have been lost; alternatively, this may be a description of the densely sericeous young fruits with their large calyx limbs that resemble corolla lobes and perhaps are whitened similarly to those of *J. frondosa*. *Joosia oligantha* is documented from a rather wide geographic range but does not appear to be common in any part of it. Andersson (1997a: 36–37, fig. 1E) presented a more detailed description and illustration of this species than in the protologue. Valencia Reyes et al. (2000) assessed the conservation status of *J. obtusa* as Vulnerable due to its small population size, but based on the same information, León Yánez et al. (2011) later considered it Critically Endangered due to its small range and threatened habitat.

13. Joosia panamensis Dwyer, Ann. Missouri Bot. Gard. 67: 262. 1980. TYPE: Panama. Veraguas: along rd. betw. Escuela Agrícola & Alto Piedra (above Santa Fe) & Río Dos Bocas ca. 5–8 km from Escuela, 730–770 m, 26 July 1974, *T. B. Croat 25932* (holotype, MO-02248047!; isotype, PMA!).

Joosia umbellifera H. Karst. var. *caucana* Steyerm., Brittonia 27: 254. 1975. TYPE: Colombia. Cauca: Río Pinche, near headwaters, NW Argelia, 1060 m, 27 Sep. 1944, *E. L. Core 1367* (holotype, US-2105761 image!; isotype, NY [barcode] NY00132048!).

Joosia umbellifera H. Karst. var. *occidentalis* Steyerm., Brittonia 27: 254. 1975. TYPE: Colombia. Valle del Cauca: Cordillera Occidental, vertiente occidental, hoya del Río Anchicayá, El Prado, 4 Aug. 1943, *J. Cuatrecasas 14827* (holotype, US-1907347 image!).

Shrubs and small trees flowering at 2 m tall, to 8 m tall; stems moderately to densely strigose to glabrescent or occasionally hirsute in some plants from eastern Panama. Leaves elliptic to obovate, 5.5–22 × 2–10 cm, at base cuneate to obtuse or occasionally acute or shortly rounded, at apex acuminate with tips 8–20 mm, drying papyraceous, adaxially moderately to densely floccose-sericeous when young then quickly becoming glabrescent, abaxially moderately to densely strigillose or strigose on costa and secondary veins and strigillose to glabrescent on remaining venation and lamina; secondary veins 8 to 18 pairs, extending to weakly unite with margins, without or occasionally with small pit-shaped domatia in abaxial axils, adaxially venation plane or costa sometimes prominulous, abaxially costa and secondary veins prominent, tertiary venation prominulous, and remaining venation plane; petioles 3–15 mm, moderately to densely strigose to glabrescent; stipules ligulate to narrowly elliptic, 8–20 mm, at apex rounded to obtuse, abaxially strigillose or sericeous to glabrous. Inflorescences cymose with 5 to 25 flowers, sparsely to densely strigillose or strigose to glabrescent; peduncles 3–7 cm; branched portion 2–3 × 4–10 cm, dichasially branched for up to 2 orders, with principal axes 2 to 4, paired or ternate, dichasial sometimes becoming monochasial in upper part, arched to straight; bracts reduced or few, ligulate to elliptic, 2–3.5 mm, rounded, and deciduous. Flowers subsessile to pedicellate, with pedicels to 2 mm; hypanthium narrowly conical to cylindrical, 2–4 mm, densely strigillose to strigose; calyx limb 1.2–5 mm, abaxially strigillose to glabrescent, 5-lobed for 1/2–3/4 its length, lobes triangular to ligulate or elliptic, acute to obtuse, erect; corolla in bud rounded at tip, at anthesis salverform, white, externally densely strigillose with deciduous trichomes ca. 0.5 mm and also hirtellous with trichomes 0.1–0.3 mm, tube 10–18 mm, ca. 1–2.5 mm diam. near middle, lobes (4)5, ligulate to triangular or elliptic, 4–6 mm, acute to obtuse, with appendages ligulate, 2–3 mm, lobed or crisped; anthers ca. 3.5 mm, included, and positioned just below corolla throat; style ca. 4.5 mm, stigmas ca. 3 mm, linear. Capsules cylindrical, straight to curved, 10–35 × 3–5 mm; seeds 7–11 mm.

Habitat and distribution. *Joosia panamensis* is found in wet forests at 10–1500 m from central Costa Rica through Panama to western Colombia and has been collected quite frequently in Panama.

Notes. *Joosia panamensis* is characterized by its pedunculate inflorescences with 15 to 25 flowers and the principal axes paired or ternate and dichasial at first then becoming shortly monochasial; its 5-merous flowers; its short to rather well-developed calyx limbs 1.2–5 mm long that are divided for one half or more of their length; its triangular to ligulate or elliptic calyx lobes that are erect in flower though sometimes spreading in fruit; its white corollas with the tubes 10–18 mm long and somewhat stout for *Joosia* (1–2.5 mm in diameter near the middle); and its somewhat stout, generally straight capsules 10–35 mm long. The corollas are densely pubescent on the outside with two layers of trichomes: the outer layer has slender strigose trichomes that are deciduous, and the inner layer has short (to ca. 0.3 mm), stout, twisted, spreading, generally persistent trichomes. Andersson (1997a) included *J. panamensis* within his circumscription of *J. umbellifera*, but *J. panamensis* lacks several of the characters Andersson used to diagnose *J. umbellifera*, including a shallowly lobed calyx limb and inflorescences with regularly elongated monochasial axes. As circumscribed here, *J. panamensis* replaces *J. umbellifera* in Central America and western Colombia. *Joosia panamensis* is similar to *J. ulei*, but *J. ulei* is found from central Ecuador through northern Peru and can be separated from *J. panamensis* by its 4-merous flowers, its calyx lobes that are spreading in flower, its rather slender corollas with tubes 0.8–1.5 mm in diameter near the middle, and its usually larger (35–40 mm long) capsules.

Joosia panamensis shows notable morphological variation, in particular in calyx limb size and form, but the variation is continuous in most features without evident correlation among any characters and several such forms are sometimes found in the same locality. Most plants of *J. panamensis* have funnelform to weakly cupuliform, shorter calyx limbs 1.2–2 mm long that are lobed for one half to two thirds of their length, with the lobes triangular to ligulate, separated from each other, and angled to rounded at the apex. These plants with the smaller calyx limbs also have leaves that are obtuse to usually acute at the base and relatively more slender capsules (2.5–3 mm in diameter); they are found at 300–1700 m in Costa Rica, throughout the range of this species in Panama, and in western Colombia (e.g., *H. W. Churchill & A. Churchill 6150*, MO; *G. McPherson 6691*, MO). The plants from Costa Rica additionally have relatively slender corolla tubes, 1–1.2 mm in diameter versus 1.5–2.5 mm in diameter from Panama and Colombia, but there are not enough mature flowering collections from Costa Rica to determine if this is a consistent difference. Another set of plants, which matches the type of *J. panamensis*, has calyx limbs 2.5–5 mm long and lobed for one half to most of their length, with the lobes ligulate to elliptic, separated or more often imbricated, and obtuse to rounded; these plants with larger calyx limbs also have leaf blades that are acute to usually obtuse or rounded at the base, stouter corollas with the tubes 2–2.5 mm in diameter, and relatively stouter capsules, 4.5–5 mm in diameter. This second group of plants is found at 10–1200 m throughout the range of *J. panamensis* in Panama (e.g., *J. Folsom 3180*, MO; *H. Kennedy & R. Foster 2136*, MO). In both of these forms the calyx limbs enlarge as the fruits develop, but in the shorter form, calyces enlarge only a little, while in the larger form they enlarge to as much as twice its size at anthesis. Some plants from western Colombia, in particular the type collections of *J. umbellifera* var. *caucana* and *J. umbellifera* var. *occidentalis*, are intermediate between these two forms with the calyx limbs divided for two thirds to three fourths of their length and ca. 3 mm, and the lobes ligulate to elliptic (e.g., *E. L. Core 1304*, MO). Steyermark separated his varieties of *J. umbellifera* based on the number of "primary" axes of the inflorescence, which apparently refers to the well-developed secondary and tertiary axes that are here called principal axes. He separated *J. umbellifera* var. *caucana* based on its three to five primary axes, in contrast to two in *J. umbellifera* var. *occidentalis* (Steyermark, 1975: 253–254). However, the number and size of principal axes are related to the degree of development of the inflorescence, which varies within *Joosia* species and even on an individual plant and does not appear to characterize distinct evolutionary groups or taxa in this case. The marked morphological diversity without apparent pattern in Central American *J. panamensis* is not yet understood. These plants may simply be better documented in Central America, or this may be a species with more morphological diversity in southern Central America than in continental South America as in some other Rubiaceae (e.g., *Raritebe palicoureoides* Wernham; Kirkbride, 1979). Further study including field observations will be needed to understand this.

14. Joosia pulcherrima Steere, Flora (Inst. Ecuat.) 3: 195. 1943. TYPE: Ecuador. Napo-Pastaza [Sucumbíos]: cantón Sucumbíos, valley Río Chingual, La Bonita, 2000 m, 6 Aug. 1943, *W. C. Steere 8018* (holotype, MICH, mounted on 2 sheets, [barcodes] 1000032A, 1000032B images!; isotypes, F-1142083 image!, F-1142084

image!, NY [barcode] NY00132045!, US-1834465 image!, US-1834466 image!, US-1859045 image!, WIS [barcode] WISv0256437-WIS image!).

Habitat and distribution. *Joosia pulcherrima* is found in wet forest vegetation at 800–2420 m in the Andes of Ecuador (Carchi, Morona-Santiago, Napo, Sucumbíos, and Zamora-Chinchipe) and Peru (Amazonas, Cusco, Huánuco, and Pasco), at least sometimes on sandstone and limestone substrates.

Notes. *Joosia pulcherrima* is characterized by its inflorescences with 10 to 20 flowers and the axes dichasial or ultimately sometimes shortly monochasial; its 4-merous flowers; its shallowly lobed calyx limbs 3.5–8.5 mm long; its corollas that are obtuse to rounded at the tip in bud with tubes 16–24 mm long at anthesis; and its rather woody, often curved capsules 25–100 mm long. The corollas are described on label data variously as pale green to pink or white externally, white to pink on the lobes, and white or yellow internally; no morphological differences are evident among the plants with these different corolla colors. The inflorescences characteristically are initially small with the axes short and the flowers congested, and then become lax as the axes elongate, often markedly, so that the flowers and capsules are well separated. This developmental change in size and form of the inflorescences and infructescences has confused identification of this species. *Joosia pulcherrima* is rather widely distributed but has not been collected frequently in any particular locality.

Steyermark (1975) and Andersson (1994) included *Joosia pulcherrima* within their circumscription of *J. dielsiana*, based mainly on the shallowly lobed calyx limb found in both species. Neither of these species was well documented in the times when they worked. With more specimens available, Andersson (1997a: 39–40, fig. 1K) then separated these two species and presented a description and illustration of *J. pulcherrima* in the circumscription adopted here. However, he separated these only after annotating a number of specimens of *J. pulcherrima* as *J. dielsiana* based on that earlier taxonomy, and those specimens were not re-annotated by him; this has generated confusion in herbarium identifications. *Joosia dielsiana* can be separated from *J. pulcherrima* by its inflorescences with more numerous flowers, generally 15 to 50, and principal axes that become markedly monochasial and secund in arrangement; its usually shorter calyx limbs 1.5–3.5 mm long; its consistently white corollas with tubes 11–12 mm long; and its usually shorter (4–34 mm long) capsules. *Joosia pulcherrima* has also been confused with *J. aequatoria*, which is found in the same general region; *J. aequatoria* can be recognized by its calyx limbs that are similar in size but lobed more deeply, for one third to two thirds of their length, and its shorter (15–28 mm long) obovoid capsules.

Steyermark considered the holotype of *Joosia pulcherrima* to be the specimen deposited at NY where Steere worked, while Andersson reported the holotype to be a specimen deposited at F. However, Stafleu and Cowan (1985) noted that the types of names published by Steere before 1950 are deposited at MICH, and there are two sheets of the type collection at MICH, both with the designation "TYPE" in Steere's handwriting. These two sheets have duplicate labels with duplicate annotations by Steere and are identified as two parts of one specimen in annotations by MICH staff as well as have the same accession number with the individual sheets identified as A and B. Based on Steere's annotations and the MICH staff's curation presumably with the knowledge of Steere's working methods, these two sheets are here considered to constitute a single specimen mounted as more than one preparation, described in ICBN Art. 8.3 (McNeill et al., 2012), and these sheets together are regarded here as the holotype of *J. pulcherrima*.

15. Joosia sericea (Standl.) C. M. Taylor, comb. nov. Basionym: *Ladenbergia sericea* Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 7: 275. 1931. TYPE: Bolivia. La Paz: Mapiri Region, San Carlos, 17 Jan. 1927, *O. Buchtien 1395* (holotype, F-608975 image!; isotypes, B† n.v., US-1443561 image!).

Ladenbergia dichotoma (Ruiz & Pav.) Klotzch var. *calycina* Wedd., Hist. Nat. Quinquinas 93. 1849. TYPE: Bolivia. La Paz: Mapiri, *H. Weddell 4337* (holotype, P n.v.; isotype, F-974853!).

Joosia multiflora L. Andersson, Brittonia 49: 31, fig. 1M. 1997. TYPE: Peru. Puno: below San Gabon on Río San Gabon, 500–1000 m, 17–24 July 1978, *M. Dillon, J. Aronson, A. Herra* [sic; Herrera] *& P. Berry 1199* (holotype, MO-2714337!; isotypes, AAU!, F n.v., MO-2740585!, NY!).

Shrubs and small trees flowering at 3 m, to 8 m tall; stems densely sericeous to glabrescent. Leaves opposite; blades elliptic to oblanceolate, 2–25 × 2–10 cm, at base cuneate to obtuse or rounded, at apex acute to usually acuminate with tips 5–15 mm, drying papyraceous to chartaceous, adaxially floccose-sericeous when young quickly becoming glabrescent, abaxially when young densely sericeous with deciduous trichomes and otherwise strigose to glabrescent

on costa and strigillose to glabrescent on remaining venation and lamina; secondary veins 14 to 20 pairs, extending to unite weakly with margins, without domatia, adaxially venation plane or costa prominulous, abaxially costa and secondary veins prominent, tertiary venation prominulous, and remaining venation plane; petioles 3–30 mm, densely strigillose to glabrescent; stipules ligulate to lanceolate-ligulate, 12–21 mm, acute to obtuse or occasionally rounded at apex, abaxially densely strigillose to glabrescent. Inflorescences cymose with 10 to 50 flowers, densely strigillose or sericeous to glabrescent; peduncles 3–8.5 cm, sometimes flexuous; branched portion 3.5–7 × 7–15 cm (not including flowers or fruits), dichasially branched for 1 or 2 orders, with principal axes 2 to 4, paired, dichasial at base then monochasial in upper part, usually markedly cincinnoid when young, becoming arched to straight; bracts reduced or few, to 1 mm, rounded. Flowers sessile to pedicellate, pedicels to 1 mm; hypanthium cylindrical, 2.5–3 mm, densely strigillose to strigose; calyx limb 3.5–7 mm, densely sericeous when young becoming puberulous to glabrescent, 4-lobed for 3/4–5/6 its length, lobes triangular to lanceolate, acute; corolla in bud acute at tip, at anthesis salverform, white, externally densely sericeous, tube ca. 15 mm, 1–1.3 mm diam. near middle, lobes 4, triangular, acute, appendages not seen unfolded; anthers ca. 4.8 mm, included; style ca. 2 mm, stigmas ca. 2 mm. Capsules cylindrical to narrowly ellipsoid, generally straight, 12–28 × 2.5–3.5 mm; seeds 3.5–5.3 mm.

Habitat and distribution. *Joosia sericea* is found in wet forest vegetation at 500–1400 m in southern Peru (Cusco, Madre de Dios, and Puno) and northern Bolivia (La Paz).

Notes. *Joosia sericea* is characterized by its pedunculate inflorescences with 10 to 50 flowers and axes that are cincinnoid when young then become elongated and monochasial with age; its 4-merous flowers; its deeply lobed calyx limbs with the lobes triangular to lanceolate and 3–5.5 mm; its white corollas that are acute at the tip in bud and have tubes ca. 15 mm; and its rather short, generally straight capsules. The calyx lobes increase in size as the flower buds mature and then increase more as the fruits mature; the size of the calyx lobes could suggest that fruiting plants belong to a different species from plants with the flowers only in bud. This is the only species of *Joosia* so far known from Bolivia. A sterile specimen of *Joosia* from Bolivia also appears to belong to *J. sericea* but lacks characters to confirm this; this specimen has quite large leaves, up to 34.5 × 9.5 cm.

Andersson (1997a) described *Joosia multiflora* based on a single specimen from southern Peru and separated it from *J. umbellifera* by its deeply lobed, well-developed calyx limbs. He circumscribed *J. umbellifera* broadly in that work to include significant morphological variation, and he diagnosed *J. umbellifera* in large part by its shorter (1.5–2.5 mm long) calyx limbs that are lobed shallowly or for up to about one half their length. The Bolivian plants of *Joosia* were not well documented at that time, and he included them in *J. umbellifera*. *Joosia* is now better documented in Bolivia (e.g., *A. Fuentes et al. 7816*, MO); these plants have a deeply lobed, 4-parted calyx limb that is a little shorter than that of the type of *J. multiflora* but otherwise similar to it and that is quite different from the shallowly lobed 5-parted calyx limbs of *J. umbellifera*. Additional morphological details and range extensions have now been documented for this species, which clearly includes the type specimen of *Ladenbergia sericea*, which is an older name than *J. multiflora*. Also included in the circumscription of this species is the type specimen of *L. dichotoma* var. *calycina*; for more details about this name, see the discussion of *J. dichotoma*. *Joosia umbellifera* also differs from *J. sericea* in its 5-merous flowers.

Joosia sericea is generally similar in aspect and many details to *J. loretensis*, which is also poorly known. *Joosia loretensis* differs from *J. sericea* in its 5-parted, generally shorter calyx limbs, with the lobes 2–3 mm long. These two species are apparently geographically separated as well with *J. loretensis* found at ca. 180 m along the northern border of Peru. Their relationship cannot be evaluated further until both of these species are better documented.

16. Joosia standleyana Steyerm., Brittonia 27: 257. 1975. TYPE: Ecuador. Zamora-Chinchipe: Quebrada Honda, vic. Rancho Achupallas, 2500–2700 m, 10 Oct. 1943, *J. A. Steyermark 54558* (holotype, F-1179383 image!; isotypes, NY [barcode] NY00132046!, US-1908636 image!).

Habitat and distribution. *Joosia standleyana* is found in wet forests at 500–2600 m, often on sandstone substrates, from southern Colombia (Putumayo) through Ecuador (Sucumbíos, Morona-Santiago, and Zamora-Chinchipe) to northern Peru (Cajamarca) and central Peru (Pasco).

Notes. *Joosia standleyana* is characterized by its pedunculate inflorescences with five to 10 flowers and the axes dichasial though often somewhat

reduced; its 4-merous flowers; its deeply divided calyx limbs 4–6.4 mm long with the lobes ligulate to elliptic, often spreading, and obtuse to rounded; its white or pink corollas with the tubes quite long (29–39 mm long); and its capsules 9–36 mm long. The inflorescences vary from subcapitate (e.g., *J. A. Steyermark 54741*, US) to shortly but laxly cymose (e.g., *G. Harling & L. Andersson 24556*, GB, NY). *Joosia standleyana* appears to be widely distributed but has not been collected frequently in any locality. Andersson (1997a: 40–41, fig. 1N) presented a description and illustration of this species in the circumscription adopted here. Newer collections document a much broader geographic range than he reported. The type collection of *J. standleyana* was annotated in Steyermark's handwriting with the species name "steyermarkii," which was attributed to Standley; however, that name was never published. The global conservation status of this species was assessed as Endangered due to threats to its habitat by León Yánez et al. (2011), but additional subpopulations have been documented since then and it is no longer endemic to Ecuador so that assessment is no longer accurate.

Joosia standleyana is similar to *J. aequatoria*; *J. aequatoria* can be separated by its calyx limbs that are lobed for two thirds or less of their length with the lobes usually erect, together with its shorter (15–28 mm long) usually obovoid capsules. *Joosia standleyana* is distinguished within the genus by its relatively large corollas, but its flowers are very poorly documented and the species is not well known in general. More than one species may be included in *J. standleyana,* but the material available is not adequate to separate smaller groups among the plants with this distinctive calyx limb form.

17. Joosia ulei Steyerm., Brittonia 27: 255. 1975. TYPE: Peru. Loreto: Pampa de Ponasa, 1200 m, Mar. 1903, *E. Ule 6795* (holotype, HBG n.v.; isotypes, F-635356 image!, G [barcode] G00436324 image!).

Habitat and distribution. *Joosia ulei* is found in wet forests at 400–2000 m from central Ecuador (Morona-Santiago and Napo) to northern Peru (Loreto).

Notes. *Joosia ulei* is characterized by its pedunculate, corymbiform inflorescences with 20 to 50 flowers, mostly dichasial axes, and generally two well-developed principal axes; its 4-merous flowers; its deeply divided calyx limbs 2–3 mm long with ligulate, usually reflexed lobes; its white corollas with the tubes 12–17 mm long and quite slender (0.8–1.5 mm in diameter) near the middle; and its often curved capsules 25–70 mm long. Steyermark (1975) originally described this species based only on one specimen from Peru, but it has now been documented rather widely there and found in Ecuador.

Andersson (1997a) included *Joosia ulei* within his circumscription of *J. umbellifera*; however, *J. ulei* lacks several of the characters Andersson used to diagnose *J. umbellifera*, in particular a shallowly lobed calyx limb and inflorescences with elongated monochasial axes, so this was apparently a confusion more than a taxonomic judgment. *Joosia ulei* is similar to *J. panamensis* in general aspect and many particular characters; however, *J. panamensis* is found in Central America and western Colombia and can be recognized by its usually more numerous leaf secondary veins, eight to 18 pairs (vs. nine to 11 pairs in *J. ulei*); its inflorescences with dichasial axes that often become shortly monochasial in the upper part; its 5-merous flowers; its calyx limbs with triangular to ligulate or elliptic lobes that are erect in flower; and its usually more robust corollas with the tubes 1–2.5 mm in diameter.

18. Joosia umbellifera H. Karst., Fl. Columb. 1: 9, tab. 5. 1858. TYPE: Colombia. Meta: Servitá, *H. Karsten & J. J. Triana s.n.* (lectotype, selected by Andersson [1997a: 32], W-134852 n.v.; isolectotype, NY [barcode] NY00132047!).

Macrocnemum polyphlebium Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 7: 15. 1930. TYPE: Colombia. Cundinamarca: Susumuco, SE of Quetame, 1200–1400 m, 8 Sep. 1917, *F. W. Pennell 1740* (holotype, US-1041903 image!; isotype, NY [barcode] NY00132131 image!).

Joosia umbellifera subsp. *macarenensis* Steyerm., Brittonia 27: 253. 1975. TYPE: Colombia. Meta: Sierra de La Macarena, central mountains, N ridge, 1500 m, 10 Jan. 1950, *W. R. Philipson, J. M. Idrobo & R. Jaramillo 2072* (holotype, US-2045105 image!; isotype, COL-43265 image!).

Shrubs and small trees flowering at 3 m tall, to 25 m tall; stems moderately to densely strigillose or sometimes glabrescent. Leaves opposite; blades elliptic to oblanceolate or broadly elliptic, 6–20 × 3.5–11 cm, at base acute to obtuse, at apex acuminate with tips 5–15 mm, drying papyraceous, adaxially glabrous or sometimes floccose-sericeous when young with rapidly deciduous trichomes, abaxially strigillose to glabrescent or sometimes costa and secondary veins densely strigose and tertiary venation sericeous with deciduous trichomes; secondary veins 12 to 16 pairs, extending to unite weakly with margins, without domatia, adaxially venation plane or costa prominulous, abaxially costa and secondary veins prominent, tertiary venation

prominulous, and remaining venation plane; petioles 6–30 mm, densely strigillose to glabrescent; stipules ligulate to narrowly elliptic, 8–18 mm, rounded to obtuse at apex, abaxially densely strigillose to glabrescent. Inflorescences cymose with 15 to 50 flowers, densely strigillose to glabrescent; peduncles 3–10 cm, often flexuous; branched portion 3–7 × 6–16 cm (not including flowers or fruits), dichasially branched for up to 3 orders, with principal axes 3 to 5(to 9), verticillate, dichasially branched at base then monochasial in elongated upper part, straight to flexuous; bracts reduced or few, ca. 0.3 mm, rounded. Flowers sessile to pedicellate, pedicels to 2 mm; hypanthium cylindrical, 2.5–4 mm, densely strigillose to glabrescent; calyx limb 1–2 mm, strigillose to glabrescent, 5-lobed for 1/4–1/2 its length, lobes deltate, obtuse; corolla in bud obtuse at tip, at anthesis salverform, white, externally pubescent with strigillose trichomes 0.4–0.5 mm and puberulous trichomes ca. 0.1 mm, tube 7–18 mm, 1–1.5 mm diam. near middle, lobes 5, narrowly triangular, ca. 5 mm, acute, with appendages flabelliform, 5–6 mm, lobed and/or crisped; anthers ca. 3 mm, included, positioned just below corolla throat; styles ca. 3 mm, stigmas ca. 1.5 mm, linear. Capsules cylindrical, straight to curved, 40–100 × 3–4 mm; seeds 7–8 mm.

Habitat and distribution. *Joosia umbellifera* is found in wet forests at 220–1400 m, at least sometimes on sandstone substrates, from central-northern and eastern Colombia (Antioquia, Boyacá, Cundinamarca, Meta, and Santander) through Ecuador (Morona-Santiago and Napo) to eastern Peru (Loreto and San Martín).

Notes. *Joosia umbellifera* is characterized by its pedunculate inflorescences with 15 to 50 flowers and the principal axes well developed, verticillate, and becoming quite elongated and monochasial; its 5-merous flowers; its rather short calyx limbs 1–2 mm long that are lobed shallowly or moderately for up to half their length; its strigillose white corollas with the tubes 7–18 mm long; and its slender, often curved capsules 40–100 mm long and 3–4 mm in diameter. The elongated, flexuous, monochasial inflorescence axes have been used to diagnose this species previously (Steyermark, 1975; Andersson, 1997a) and are distinctive when they are developed. These axes characteristically continue to develop as flowering proceeds, so the axes are longer and have many more flowers when older than when flowering commences. When flowering begins and on generally depauperate plants, the inflorescence axes may be rather short and straight (e.g., *A. E. Lawrance 171*, *440*, both MO). Several plants seen of *J. umbellifera* have a distinctive curl or spiral form in both the inflorescence axes (e.g., *S. Hoyos & J. J. Hernández 555*, MO) and individual abnormal capsules (e.g., *W. Palacios et al. 15584*, MO; *H. Karsten s.n.*, NY [barcode] NY00132047). *Joosia umbellifera* has been collected occasionally over a relatively broad range along the eastern slopes of the Andes in Colombia and Peru.

Joosia umbellifera was circumscribed more broadly by Steyermark (1975), who included in *J. umbellifera* the plants of western South America that are here separated as *J. panamensis*. The circumscription in this present work of *J. umbellifera* basically corresponds to Steyermark's *J. umbellifera* subsp. *umbellifera* var. *umbellifera* plus his *J. umbellifera* subsp. *macarenensis*. The plants included by Steyermark in his *J. umbellifera* subsp. *umbellifera* var. *caucana* Steyerm. and *J. umbellifera* subsp. *umbellifera* var. *occidentalis* Steyerm. are here included in *J. panamensis*. Andersson (1997a) later circumscribed *J. umbellifera* much more broadly than Steyermark did and did not recognize any infrageneric taxa. In Andersson's circumscription, *J. umbellifera* was found throughout the range of the genus and was highly variable morphologically, with the flowers 4- or 5-merous, the calyx limb shallowly to very deeply lobed, and the capsules 8–100 mm long (Andersson, 1997a: 33). Andersson explicitly diagnosed his circumscription *J. umbellifera* by elongated, multi-flowered, cincinnoid ultimate axes of the inflorescences, calyx limbs 1.5–2.5 mm long and lobed for half or more of their length with triangular lobes 0.5–1 mm long, corollas with tubes 10–18 mm long, and capsules 2–3 mm in diameter; although in practice he also included here specimens with short inflorescence axes, longer calyx limbs with longer lobes, smaller corollas, and stouter capsules. Andersson included within *J. umbellifera* all of Steyermark's infrageneric taxa of this species plus *J. panamensis* and *J. ulei*. The circumscription and characterization of *J. umbellifera* in this present work are different from Andersson's, in particular *J. panamensis*, *J. ulei*, and *J. sericea* are separated and the flowers of *J. umbellifera* are considered consistently 5-merous. Andersson (1997a: 34) commented that the specimen *Hoyos & Hernández 555* was similar to *J. umbellifera* but unusual in its small calyx and sparse pubescence of the ovary, but more collections now available from Colombia document continuous variation in these features in this species and this particular specimen is no longer a morphological outlier.

The name *Cinchona dichotoma* was apparently based on a specimen of *Joosia umbellifera*, but the identity of the type specimen of this name is not

entirely clear and Andersson selected a conserved type for that name that represents a different species from *J. umbellifera* (Andersson, 1996); for more detail, see the discussion under *J. dichotoma*. A specimen of *J. umbellifera* deposited at F, *Triana 3272/3*, was collected in Susumuco, Colombia, in 1856 and was annotated by Donald Simpson as a possible isotype of *J. umbellifera*. This is not implausible, because the type collection of *J. umbellifera* was made by Karsten on a trip together with Triana during that year and apparently to that particular area. Karsten's specimen locality was labeled as "Servitá," and the location of this place is not clear but was described by Karsten as located on the eastern slopes of the Cordillera de Bogotá above a grassy plain. This locality may be near or the same as Susumuco, and the Triana collection thus a topotype. However, without label data that correspond to the information in the protologue of *J. umbellifera* or list Karsten as part of the collecting team, or any other documentation that these specimens comprise one gathering, this specimen cannot conclusively be considered an isotype.

Several specimens from Amazonian southern Colombia, along the Río Caquetá at ca. 450 m elevation in Santa Rosa municipality (*J. Rubiano, C. Moreno, P. Orrijos & A. Espitia 062*, *963*, both COL), are generally similar to *Joosia umbellifera* but more robust and a bit different in aspect. These differ from other plants of *J. umbellifera* in their larger (24–29 × 7–11.5 cm) leaves, their often larger stipules (up to 30 mm long), and their longer (15–17 cm long) peduncles. These have only very young flower buds and cannot be conclusively identified. These plants may represent an unusual population of *J. umbellifera*, or they may belong to a separate undescribed species; flowers and fruits will be needed to further evaluate their status.

Incompletely Known Taxa

19. Joosia sp.

Steyermark also included in *Joosia umbellifera* two collections from Táchira, in the Cordillera Oriental of the Andes in western Venezuela (vic. Las Minas, N of La Laguna, 16 km SE of Santa Ana, 7°36′N, 72°13′W, 1150–1250 m, 28 July 1979, *J. A. Steyermark & R. Liesner 118907*, MO, NY; and Cerro Las Minas, 18–20 km SE of Santa Ana, 7°36′S, 72°13′W, 1150–1250 m, 10 Nov. 1979, *J. A. Steyermark, R. Liesner & A. González 119800*, MO, NY). These specimens clearly belong to *Joosia* and are similar to *J. umbellifera* but have only very young flower buds and immature fruits, respectively. These differ from *J. umbellifera* in their inflorescences with relatively quite short axes and only about 10 to 15 flowers. These specimens do document *Joosia* in Venezuela and were collected after the Rubiaceae floristic treatment for Venezuela was published (Steyermark, 1974), so *Joosia* was not reported there. These two specimens were annotated as *J. umbellifera* by Andersson (in sched. 1992), although this locality and the distribution of *Joosia* in Venezuela were not noted in Andersson's published treatment of *Joosia* (1997a).

Although the genus identification of these Venezuela plants is clear, their species identity is not. These collections are from an area with an unusual localized sandstone substrate with an unusual flora (R. Liesner, pers. comm.). The condition of these *Joosia* specimens is not adequate to confirm they belong to a known species or exclude the possibility that they are undescribed.

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Rubiacearum Americanarum Magna Hama Pars XXXVI: New Species and Taxonomic Changes in *Palicourea* (Palicoureeae)

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Abstract. The identity, circumscription, and nomenclatural details of some species of "traditional" *Palicourea* Aubl. and one section are studied here. The species belong to both subgenera of *Palicourea*. Three species are re-circumscribed, two names are lectotypified, four new nomenclatural combinations are published, eight species of *Palicourea* subg. *Montanae* C. M. Taylor are newly described, and several names are newly synonymized. In *Palicourea* subg. *Palicourea*: the new combination *Palicourea paulina* (Standl.) C. M. Taylor is based on *Psychotria paulina* Standl. and is an older name for *Palicourea plowmanii* D. R. Simpson ex C. M. Taylor. The circumscription and morphological characterization of *Palicourea* sect. *Corymbiferae* (Müll. Arg.) C. M. Taylor are expanded, nine species are included, and *Psychotria* L. sect. *Regina* Müll. Arg. is synonymized here. The name *Psychotria corymbifera* Müll. Arg. is typified. *Palicourea quadrifolia* (Rudge) DC. subsp. *leticiana* C. M. Taylor is recognized as a species that takes the name *Palicourea lucidula* Standl. The new combination *Palicourea regina* (Müll. Arg.) C. M. Taylor is based on *Psychotria regina* Müll. Arg. The morphology of *Palicourea virens* (Poepp.) Standl. is evaluated, and *Palicourea quinata* Suess. is synonymized here. In *Palicourea* subg. *Montanae*: *Palicourea albocaerulea* C. M. Taylor is newly reported from Honduras. The new species *Palicourea betancuriana* C. M. Taylor of northwestern Colombia differs from *Palicourea standleyana* C. M. Taylor by its longer calyx limbs and purple corollas. The new combination *Palicourea ceriantha* (K. Schum.) C. M. Taylor is based on *Rudgea ceriantha* K. Schum. and is an older name for *Palicourea clerodendroides* C. M. Taylor. The new species *Palicourea foreroi* C. M. Taylor of western Andean Colombia differs from *Palicourea pyramidalis* Standl. by its longer pedicels and corollas. The new species *Palicourea hondurensis* C. M. Taylor of Honduras differs from *Palicourea albocaerulea* by its short calyx lobes and usually longer stipule lobes. The new species *Palicourea kahirica* C. M. Taylor of western Andean Colombia differs from *Palicourea lehmannii* (K. Schum. & K. Krause) Standl. by its shorter corollas without abaxial horns on the lobes. The new species *Palicourea lozanoana* C. M. Taylor of eastern Andean Colombia differs from *Palicourea denslowiae* J. H. Kirkbr. by its laminar stipules, shorter calyx limbs, and corollas without abaxial horns on the lobes. The new species *Palicourea murciae* C. M. Taylor of Andean Colombia differs from *Palicourea weberbaueri* K. Krause by its dense velutinous pubescence and shorter corollas. The new species *Palicourea parrana* C. M. Taylor of eastern Andean Colombia differs from *Palicourea petiolaris* Kunth by its longer corollas. The new combination *Palicourea sanchezii* (C. M. Taylor) C. M. Taylor is based on *Psychotria sanchezii* C. M. Taylor. The new species *Palicourea sancti-ciprianii* C. M. Taylor of western coastal Colombia and northwestern Ecuador differs from *Palicourea vulcanalis* Standl. ex C. M. Taylor by its stipules with shorter sheaths and its smaller inflorescences.

Key words: Bolivia, Brazil, Colombia, Ecuador, Guianas, Honduras, *Palicourea*, Palicoureeae, Peru, *Psychotria*, Psychotrieae, Rubiaceae, *Rudgea*, Venezuela, World Flora Online.

The Neotropical genus *Palicourea* Aubl. (Palicoureeae, Razafimandimbison et al., 2014; Psychotrieae s.l., Bremer & Eriksson, 2009) has traditionally been distinguished in the Rubiaceae by its tissues with raphides; persistent stipules that are united around the stem to almost interpetiolar (i.e., laminar) and bilobed on each side of the stem; 5-merous distylous flowers; corollas with valvate aestivation; solitary ovules that are basal in each locule; and blue to black drupaceous fruits with two planoconvex, generally hard-walled pyrenes. Many *Palicourea* species have adaptations for hummingbird pollination, which include brightly colored inflorescences—blue, purple, red, orange, or yellow—with the flowers usually pedicellate or otherwise well separated from each other, along with well-developed tubular corollas that are also brightly colored. The corollas are swollen at the base and a substantial amount of nectar accumulates in this basal portion; this nectar is also covered inside the flower by a dense ring of pubescence (Taylor, 1997). This internal pubescent

ring apparently restricts access to the nectar by many of the flower's visitors. The basal swelling and curved tube of the corolla, and in some cases also the arrangement of the anthers, range in *Palicourea* from actinomorphic to zygomorphic, with the form sometimes consistent within a species but more often varying among the flowers on an inflorescence. In many species of *Palicourea* the flowers have a consistently outward orientation, so they are easily accessible to pollinators; some flowers of an inflorescence do not need to bend to achieve this but other flowers do. There is a notable variety of inflorescence and corolla colors among these *Palicourea* species, which suggests this group has radiated in part in response to pollinator-mediated selection. However, the specific functions or relationships of the inflorescence and corolla colors to pollination in *Palicourea* are not yet understood, beyond the hypothesis that competition for pollinators favors divergence in floral color display among related species that grow together (Muchhala et al., 2014). Species of *Palicourea* are generally distylous, though this condition has been lost in some peripheral populations of some species (Sobrevila et al., 1983) and varies regionally in some species (Taylor, 1993). Two flowering specimens, one long-styled and the other short-styled, are adequate to document that a species of *Palicourea* is distylous, but if collectors are not aware of the need to document both forms then one form can be overlooked. Thus, numerous randomly collected specimens and sometimes also targeted field observations are needed to confirm whether a species or population is distylous.

Traditionally, *Palicourea* has included ca. 200 species of shrubs and small trees found from sea level to the montane treeline in the American tropics. Taylor (1997) presented a detailed morphological description of traditional *Palicourea*, along with an infrageneric classification of this group with two subgenera and several sections; this group has high diversity in montane regions, in particular in the Andes and southern Central America. Additionally, recent morphological and molecular studies find that *Palicourea* actually includes more species than have been traditionally classified here, and these species have widely varied pollination modes and are also well represented in lowland regions (Paul et al., 2009; Taylor et al., 2010; Taylor, 2015a, 2015b). Most of those additional species of *Palicourea* have been classified until recently in *Psychotria* L.; however, not all the ca. 800 Neotropical species originally named in *Psychotria* belong to *Palicourea* (Taylor & Gereau, 2013). The key below separates these genera. Study of the full circumscription of *Palicourea* is underway (Taylor et al., 2010; Taylor, 2015a, 2015b), and this group is estimated to include ca. 600 species pollinated variously by insects and birds. The new species described here all belong to traditional *Palicourea* (sensu Taylor, 1997), and their placements in the infrageneric classification of that group are noted.

Morphological interpretation of inflorescence position in *Palicourea* has varied among authors and generated some confusion. Many species show variation in the development of the bracts subtending the basalmost pair of secondary axes, and the size of these bracts and how they are described can change the interpretation of inflorescence form even though the inflorescences are all basically the same developmentally. The inflorescence bracts are presumably homologous to vegetative leaves, and the bracts subtending the basalmost pair of secondary axes may vary in *Palicourea* species from reduced and triangular (as bracts are usually defined) to foliaceous (i.e., leaf-like) and sometimes also have reduced stipules. Often a local *Palicourea* population or even an individual plant will show continuous variation in this feature, but study specimens are discrete samples of this variation and do not always document the full range of variation. When the bracts subtending the basalmost secondary axes are reduced, the inflorescence is clearly terminal and borne from a single peduncle. However, when the bracts at this position become enlarged or foliaceous, the inflorescence has been interpreted by some authors as "sessile and tripartite" with the two secondary axes now considered additional peduncles (e.g., Standley, 1936). Similar variation in terminal inflorescences is found in other Rubiaceae, where it has sometimes been called "terminal and lateral" (e.g., Andersson & Taylor, 1994). Here the inflorescences of *Palicourea* are considered to be terminal and pedunculate with some variation in the degree of development of the bracts that subtend the basalmost pair of secondary axes (Taylor, 1997). The alternative description "sessile and tripartite" is also provided here to aid users of these descriptions who are not familiar in detail with Rubiaceae morphology.

Recent exploration has discovered several new species, described here, of traditional *Palicourea* from Central America and northwestern South America. Additional documentation of previously known species has also clarified their identities and circumscriptions, resulting in some notable range extensions and the need for several nomenclatural changes. These taxonomic updates prepare for the World Flora Online.

This work is based on standard herbarium techniques. Additional specimen data and high-resolution scans of representative specimens of the species studied here are available online in the TROPICOS® database and its Rubiaceae Project. The taxa treated here are arranged by subgenus, and within each subgenus by rank, and within each rank in alphabetical order. Morphological terminology follows Lawrence (1951), Robbrecht (1988), and Taylor et al. (2010). Comparative sizes mentioned in discussions refer only to other species of *Palicourea*. Morphological measurements are based on dried specimens. Habitat and distribution are summarized for all the species treated here, but phenology is only summarized for taxa newly described because only those are comprehensively detailed. The names *Psychotria* and *Palicourea* are nomenclaturally distinct but similar and commonly confused; therefore, the non-standard abbreviations *Psy.* and *Pal.*, respectively, are used in the text here for clarification. The lectotypification here of *Rudgea ceriantha* K. Schum. is co-authored with Piero Delprete, while the lectotypification of *Psy. corymbifera* Müll. Arg. here is authored solely by C. M. Taylor.

Key to *Palicourea* and *Psychotria* in the Neotropics

1. Stipules persistent with leaves, when fallen leaving no persistent trichomes or these clear and < 0.5 mm long; leaves without foveolate domatia; fruits at maturity blue, purple-black, or white, sometimes passing through an immature orange or red stage; pyrenes with marginal and/or abaxial preformed germination slits (PGSs), with or without basal raphal opening, without red ethanol-soluble pigment; plants drying green or some individual species consistently drying reddish brown or blackened ..... *Palicourea* Aubl.

1′. Stipules caducous or occasionally persistent on distalmost 1 or 2 nodes, when fallen leaving a ring of persistent reddish brown or gray trichomes, these usually 0.5–1 mm long; leaves without or sometimes with foveolate domatia; fruits red at maturity; pyrenes without PGSs, with or without basal raphal opening, with red ethanol-soluble pigment; plants drying grayish green, gray, reddish brown, brown, or blackened with drying color often varied for individual species ..... *Psychotria* L.

I. Palicourea Aubl. subg. **Palicourea**

1. Palicourea paulina (Standl.) C. M. Taylor, comb. nov. Basionym: *Psychotria paulina* Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 17(2): 219. 1937. TYPE: Brazil. Amazonas: Mun. São Paulo de Olivença, basin of Rio Solimões, July 1936, *B. A. Krukoff 7839* (holotype, NY [barcode] NY00132772 image!).

Palicourea plowmanii D. R. Simpson ex C. M. Taylor, Novon 4(1): 57, fig. 1C, D. 1994, syn. nov. TYPE: Peru. San Martín: Lamas, Naranjal, trail to Jorge Chávez, Km. 85 of Tarapoto–Yurimaguas rd., 6°17′S, 76°17′W, 2 Apr. 1986, *S. Knapp & J. Mallet 6940* (holotype, MO-5338846!; isotype, MO-5338845!).

Habitat and distribution. This species is found in wet forest at 186–1100 m in the western Amazon basin, in western Brazil, southeastern Colombia, eastern Peru, and northeastern Bolivia.

Notes. The type of *Psychotria paulina* is distinctive in its large leaves and stipules along with its subcapitate inflorescences with well-developed bracts, but this species was only known from one specimen in young fruit and so its identity was unclear for some time. Good documentation during the last decade of flowers, fruits, and morphological variation in *Palicourea plowmanii* along with documentation that *Pal. plowmanii* grows in western Brazil now show that the name *Psy. paulina* applies to this same species. *Palicourea paulina* belongs to *Palicourea* subg. *Palicourea* sect. *Crocothyrsae* Griseb. ser. *Croceae* (Müll. Arg.) K. Schum. subser. b.

Palicourea sect. **Corymbiferae** (Müll. Arg.) C. M. Taylor, Ann. Missouri Bot. Gard. 84(2): 232. 1997. *Psychotria* sect. *Corymbiferae* Müll. Arg., Fl. Bras. 6(5): 229, 245. 1881. TYPE: *Palicourea corymbifera* (Müll. Arg.) Standl. (lectotype, designated by Taylor, 1997: 232).

Psychotria L. sect. *Regina* Müll. Arg., Fl. Bras. 6(5): 222, 318. 1881, syn. nov. TYPE: *Psychotria regina* Müll. Arg. [≡ *Palicourea regina* (Müll. Arg.) C. M. Taylor].

Notes. New specimens and field observations in Brazil shed more light on the species and characters of this section, which is here expanded beyond the circumscription of Taylor (1997). Four species were previously included here, *Palicourea corymbifera* (Muell. Arg.) Standl., *Pal. irwinii* Steyerm., *Pal. quadrifolia* (Rudge) DC., and *Pal. virens* (Poepp.) Standl., and the morphological characterization was limited. These four species were said to have shiny, verticillate leaves and subtruncate stipules, but further study shows some variation in these features. In particular, the stipules sometimes have two small to clearly developed lobes on each interpetiolar side, and the leaves vary from ternate to opposite in *Pal. virens*. These four species all have subcapitate to lax, rounded-corymbiform inflorescences, with the secondary axes as long as the primary axis, which is an unusual form in *Palicourea*. These species have been described as having pyramidal inflorescences by

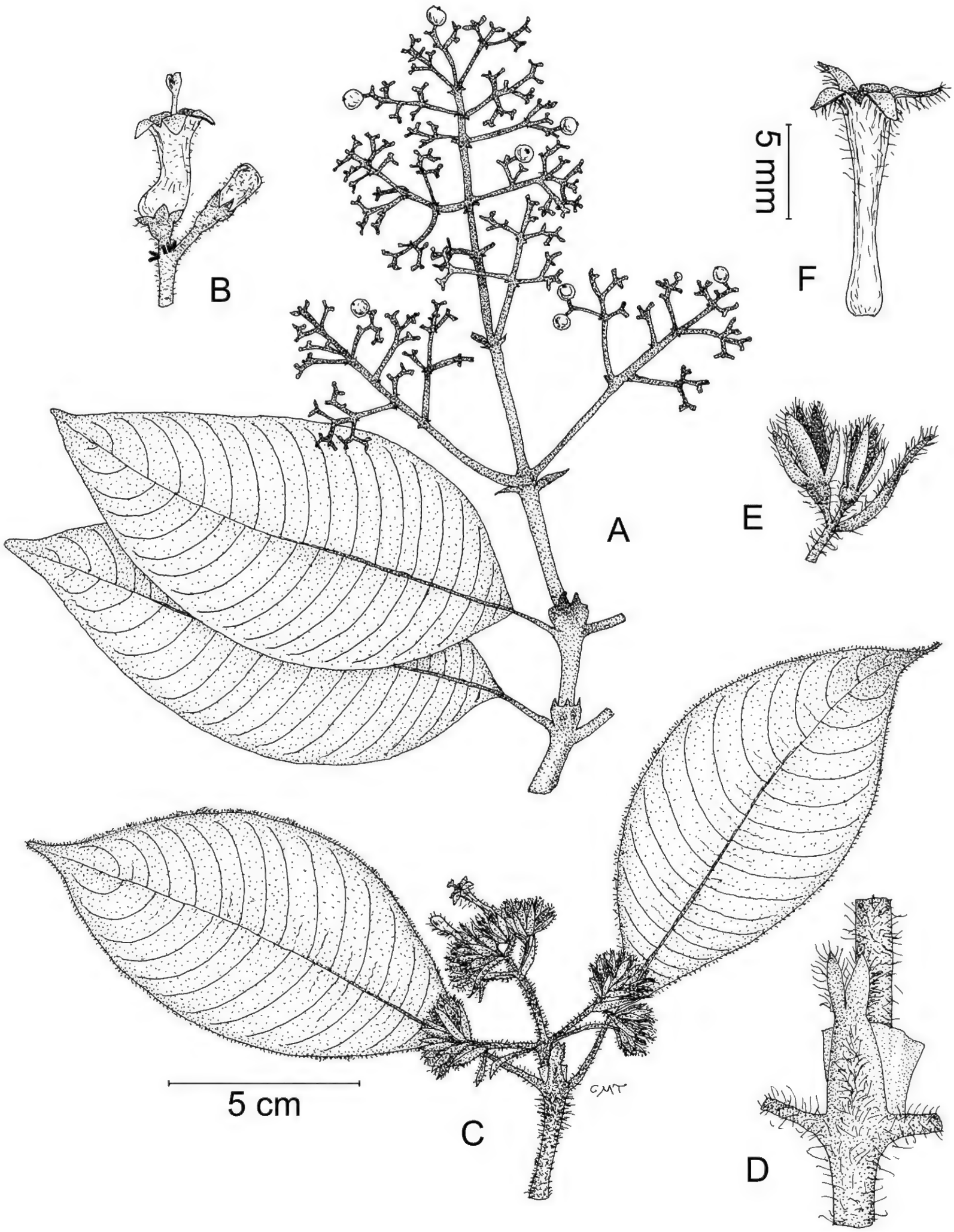

Figure 1. A, B. *Palicourea murciae* C. M. Taylor. —A. Fruiting branch. —B. Portion of inflorescence with one flower in bud and one flower at anthesis. C–F. *Palicourea betancuriana* C. M. Taylor. —C. Flowering branch. —D. Portion of stem with node, stipule, and basal portions of two petioles. —E. Portion of inflorescence with two flowers from which corollas have fallen. —F. Corolla. A, B based on *A. S. Barclay et al. 3188* (US); C based on *J. L. Zarucchi et al. 5740* (MO); D based on *D. Sánchez et al. 879* (MO); E, F based on *P. Pedraza-Peñalosa et al. 2089* (MO). Scale bars: A, C = 5 cm; B, D–F = 5 mm.

some other authors, but their inflorescences are not pyramidal as described by Taylor (i.e., with the primary axis longer and having more nodes than the secondary axes). The inflorescences of these four species of *Palicourea* sect. *Corymbiferae* are yellow to red and often markedly deflexed with the peduncle geniculate at the base, another unusual form in this genus. The corollas are white to yellow or orange and distinctive as well as unusual in form for *Palicourea*. These corollas are tubular to weakly funnelform and have relatively short lobes that often are erect rather than spreading at anthesis. These corollas do have the ring of internal pubescence near the base of the tube characteristic of *Palicourea*, but they are not markedly swollen at the base. These corollas are also often constricted at the throat so that the tube is weakly inflated in its upper half. The fruits of these four species have pyrenes that are broadly angled to smooth abaxially, with variously two to five pyrenes per fruit.

Several additional *Palicourea* species have these unusual inflorescence and flower characters, together with similar fruit characters, stipules with developed lobes, and paired shiny leaves. Thus, these additional species appear to be related to *Pal. corymbifera* and are here included in *Palicourea* sect. *Corymbiferae*. Species with verticillate leaves newly included in this section are *Pal. comitis* (Müll. Arg.) Steyerm. of Brazil and the Guianas and *Pal. cardonae* Steyerm. of Venezuela, Brazil, and the Guianas. Species with opposite leaves newly included here are *Pal. bracteosa* Standl., *Pal. lucidula* Standl., and *Pal. regina*. *Palicourea regina* was the only species included in *Psychotria* sect. *Regina*, so this sectional name now becomes a synonym of *Palicourea* sect. *Corymbiferae*. These two sections were published simultaneously (Mueller, 1881), and the name *Psychotria* sect. *Corymbiferae* is here chosen for the combined group because this name has been used recently (Taylor, 1997) while the other name has not been applied since its publication. The identities of some of the species included in this section are newly clarified and discussed below.

KEY TO THE SPECIES OF *PALICOUREA* SECT. *CORYMBIFERAE*

1. Leaves opposite (i.e., 2 per node); stipules on each interpetiolar side with truncate sheath and 2 narrowly triangular lobes that are longer than the sheath, with sheath generally not splitting with age in intrapetiolar portion; flowers distylous with reciprocal positioning of anthers and stigmas; stigmas and pyrenes 2 to 3.
   2. Inflorescence bracts 1–3 × 0.3–1.5 mm, linear to narrowly triangular, ligulate, or elliptic ..... *Palicourea lucidula* Standl.
   2′. Inflorescence bracts 3–25 × 0.5–5 mm, narrowly to broadly ligulate or elliptic.
      3. Inflorescence bracts 20–25 × 3–6 mm ..... *Palicourea regina* (Müll. Arg.) C. M. Taylor
      3′. Inflorescence bracts 3–15 × 0.5–5 mm.
         4. Inflorescence bracts ligulate to broadly elliptic, 1–5 mm wide; plants found in northern and western Amazon basin ..... *Palicourea bracteosa* Standl.
         4′. Inflorescence bracts narrowly ligulate, 0.5–1.2 mm wide; plants found in central Amazon basin ..... *Palicourea virens* (Poepp.) Standl. p.p.

1′. Leaves 3 to 5 per node; stipules on each interpetiolar side truncate to undulate, entire or fringed with colleters, shortly erose, or with linear to narrowly triangular lobes that are shorter than the sheath, with sheath often splitting with age in intrapetiolar portion into ovate to broadly triangular interpetiolar segments; flowers distylous with stigmas perhaps varied in position between forms but anthers apparently in same position in both forms; stigmas and pyrenes 2 to 5.
   5. Inflorescence bracts 3–15 mm long, with at least a few of them 4 mm long or longer; stigmas and pyrenes 5. ..... *Palicourea virens* p.p.
   5′. Inflorescence bracts reduced, or developed and up to 3 mm long; stigmas and pyrenes 2 to 5.
      6. Calyx limb developed, ca. 1 mm long, lobed for more than 1/2 its length, with lobes ligulate ..... *Palicourea irwinii* Steyerm.
      6′. Calyx limb reduced to rather short, 0.2–0.6 mm long, truncate to undulate, or lobed for less than 1/2 its length with lobes triangular.
         7. Inflorescence bracts reduced or shortly developed, up to ca. 1 mm long and ca. as long as calyx limb; stigmas and pyrenes 2 to 5.
            8. Corollas smooth externally; stigmas 5; pyrenes 5, wedge-shaped, often abaxially with thickened angles ..... *Palicourea comitis* (Müll. Arg.) Steyerm.
            8′. Corollas externally with tubercles or extruded folds at bases of sinuses between lobes; stigmas 2 or 3; pyrenes 2 or 3, hemispherical to broadly wedge-shaped, abaxially smooth or with broad angles that are not thickened ..... *Palicourea corymbifera* (Müll. Arg.) Standl.
         7′. Inflorescences with at least a few bracts developed (these may be deciduous as fruits mature) up to 1–3 mm long and longer than calyx limb; stigmas and pyrenes 2 to 3.
            9. Inflorescences with peduncles 1–3 cm long, with branched portion 2–4 × 2.5–7 cm with axes stout; calyx with 3 colleters in each sinus between lobes ..... *Palicourea cardonae* Steyerm.
            9′. Inflorescences with peduncles 3–10 cm long, with branched portion 2–7 × 3–15 cm with axes generally slender at least in flower; calyx with 1 colleter per sinus ..... *Palicourea quadrifolia* (Rudge) DC.

2. Palicourea corymbifera (Müll. Arg.) Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 7: 127. 1930. *Psychotria corymbifera* Müll. Arg., Fl. Bras. 6(5): 247, tab. 35. 1881. TYPE: Brazil. Amazonas: prov. Alto Amazonas, secus Rio Negro in vicinitate Barra, Oct. 1851, *R. Spruce sub Palicourea n. 3, 1223* (lectotype, designated here, G [barcode] G00300598!; isolectotype, K [bc] K000471457 image!).

Habitat and distribution. *Palicourea corymbifera* is found in wet lowland forest at 85–800 m in the Amazon basin, in southern Venezuela, the Guianas, Brazil, southern Colombia, eastern Ecuador, eastern Peru, and northern Bolivia.

Notes. *Palicourea corymbifera* is a commonly collected species in the Amazon basin and has been treated in various floras, but its name has not been typified until now. Four specimens were cited by collector and number in the protologue and thus are syntypes. Steyermark (1972: 758) then selected *Spruce sub Palicourea n. 3, 1223* as the type collection of *Psychotria corymbifera* but did not designate a single specimen of this collection as the type to complete the lectotypification. The flowering specimen of this collection in Mueller's herbarium at G is therefore here designated the lectotype. Two specimens at K also have this number, but they have different collection dates from each other and therefore cannot be considered to belong to a single gathering. One of these K specimens has flowers, and the other has fruits. The flowering specimen is labeled as collected in October and thus is an isolectotype. The fruiting collection (K [barcode] K000471458 image) is labeled as collected in February and thus is not an isolectotype. As noted above, *Pal. corymbifera* belongs to *Palicourea* sect. *Corymbiferae*.

3. Palicourea lucidula Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 8: 225. 1930. TYPE: Peru. Loreto: Santa Rosa, lower Río Huallaga below Yurimaguas, 135 m, 1–5 Sep. 1929, *E. P. Killip & A. C. Smith 28816* (holotype, F-607736!).

Palicourea lucentifolia Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 8: 223. 1930, syn. nov. TYPE: Peru. Loreto: La Victoria on Amazon River, 29 Aug. 1929, *Llewelyn Williams 2906* (holotype, F-604457!).

Palicourea quadrifolia (Rudge) DC. subsp. *leticiana* C. M. Taylor, Novon 5(4): 382. 1995, syn. nov. TYPE: Colombia. Amazonas: Parque Nacional Natural Amacayacu, 24 June 1991, *A. Rudas Lleras, P. A. Palacios, S. Duque, F. del Aguila Joaquin & G. Morán 2437* (holotype, COL!; isotypes, MO-3933506!, MO-4258973!).

Habitat and distribution. *Palicourea lucidula* is found in wet forest at 100–600 m in the western Amazon basin, in southern Colombia, eastern Ecuador, and eastern Peru.

Notes. *Palicourea lucidula* is characterized by its opposite leaves, stipules with truncate sheaths and narrowly triangular lobes that are as long as or longer than the sheath, corymbiform inflorescences with regularly developed bracts 1–3 × 0.3–1.5 mm, tubular to weakly funnelform corollas, and somewhat didymous fruits with abaxially smooth pyrenes. The bracts vary in size and form rather notably, in part at least in correlation with developmental stage of the flowers and fruits. The bracts are generally rather small when the inflorescences form, then enlarge markedly as the flowers mature, and then enlarge more and change from yellow to purple as the fruits mature. *Palicourea lucidula* is quite similar to *Pal. quadrifolia*, as noted previously when these plants were treated as a subspecies of *Pal. quadrifolia* (Taylor, 1995). However, more material is now available and shows that these plants are better regarded as a species distinct from *Pal. quadrifolia*. *Palicourea quadrifolia* can be recognized by its verticillate leaves and stipule sheaths that are truncate to undulate or have lobes that are shorter than the sheath. *Palicourea lucidula* is also similar to *Pal. bracteosa*, which was also poorly known until recently; *Pal. bracteosa* can be recognized by its longer bracts 3–15 mm long.

The names *Palicourea lucentifolia*, *Pal. lucidula*, and *Pal. quadrifolia* subsp. *leticiana* all apply to the same species, and the first two were described simultaneously. The name *Pal. lucentifolia* was synonymized previously with *Pal. quadrifolia* subsp. *leticiana* (Taylor, 1995), while the identity of *Pal. lucidula* has not been clear previously. Because the circumscription of this species is substantially changed here, the name *Pal. lucidula* is chosen for this species; a different name better serves for a new classification. As noted above, *Pal. lucidula* belongs to *Palicourea* sect. *Corymbiferae*.

4. Palicourea regina (Müll. Arg.) C. M. Taylor, comb. nov. Basionym: *Psychotria regina* Müll. Arg., Fl. Bras. 6(5): 318. 1881. TYPE: Brazil. Amazonas: in regione Japurensi, s.d., *C. F. P. Martius s.n.* (holotype, M n.v., M as photo F neg. 6100 at MO-01695326!; isotype, G [barcode] 00300407!).

Habitat and distribution. *Palicourea regina* is known from humid lowland vegetation in the Rio Japurá basin in northwestern Brazil.

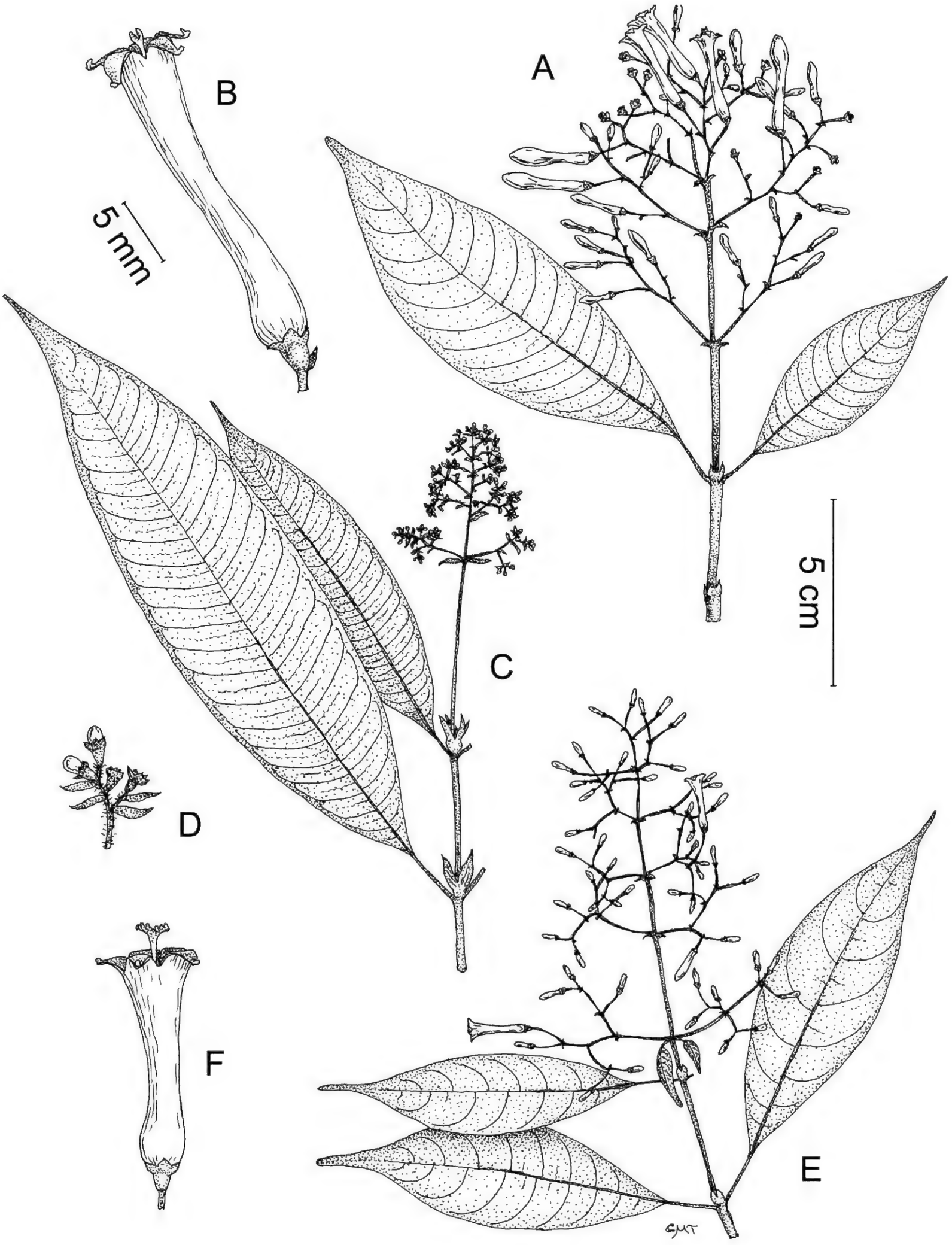

Figure 2. A, B. *Palicourea kahirica* C. M. Taylor. —A. Flowering branch. —B. Flower at anthesis. C, D. *Palicourea sancti-ciprianii* C. M. Taylor. —C. Flowering branch. —D. Portion of inflorescence with two flowers in bud and two flowers from which corollas have fallen. E, F. *Palicourea foreroi* C. M. Taylor. —E. Flowering branch. —F. Flower at anthesis. A, B based on *S. Díaz P. 3717* (COL); C, D based on *R. Ruíz et al. 31* (COL); E, F based on *C. M. Taylor et al. 12044* (MO). Scale bars: A, C, E = 5 cm; B, D, F = 5 mm.

Notes. *Palicourea regina* was described in *Psychotria* because Mueller (1881) included the species of *Palicourea* s.l. in that genus (Taylor, 1996). In our current classification *Psy. regina* clearly belongs to *Palicourea* and is here transferred to this genus. *Palicourea regina* is characterized by its opposite, relatively large leaves with blades up to 40 × 16 cm and 16 to 20 pairs of secondary veins; its persistent stipules that are united around the stem into a short truncate sheath and have two short triangular lobes on each interpetiolar side; its pedunculate congested-cymose to subcapitate inflorescences with well-developed bracts 20–25 mm long; and its tubular-funnelform corollas. The bracts are acute to acuminate at their tips. The corollas were described in the protologue as being elongated (Mueller, 1881: 318), similar to those of *Pal. guianensis* Aubl. and *Pal. grandifolia* (Willd.) Standl., and 2.5 mm long; however, this measurement appears to be a typographical error for 2.5 cm. This longer measurement agrees with the one corolla that is visible on the G specimen and also agrees with the general length of the corollas of *Pal. guianensis* and *Pal. grandifolia*. The color of the inflorescence of *Pal. regina* is unknown, and the fruits are apparently not documented.

Although *Palicourea regina* is not well known, it appears to be a distinct though infrequently encountered species. *Palicourea regina* has been confused in sched. with *Psychotria lupulina* Benth.; however, *Psy. lupulina* can be separated by its smaller leaves (up to 24 × 10 cm) with 6 to 15 pairs of secondary veins and its shorter corollas (9–12 mm long). *Palicourea regina* appears to be related to *Pal. bracteosa* and *Pal. lucidula* and is here classified together with them in *Palicourea* sect. *Corymbiferae* as discussed earlier in this article. These species all have opposite leaves along with the other distinctive characters of this section; however, *Pal. bracteosa* and *Pal. lucidula* both differ from *Pal. regina* in their smaller bracts (1–15 mm long) and their ranges generally farther west, in Peru, Ecuador, and southern Colombia.

5. Palicourea virens (Poepp.) Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 11(5): 232. 1936. *Psychotria virens* Poepp., Nov. Gen. Sp. Pl. 3: 33. 1845. TYPE: Brazil. Amazonas, ad Ega [Tefé], Oct. 1831, *E. Poeppig s.n.* (holotype, W n.v.; isotype, NY [barcode] 00132864 image!).

Palicourea quinata Suess., Revista Sudamer. Bot. 7: 165. 1943, syn. nov. TYPE: Brazil. Amazonas: Manaus, 16 Aug. 1928, *P. von Luetzelburg 21966* (holotype, M [barcode] M-0198479 image!).

Habitat and distribution. *Palicourea virens* is found in wet lowland forest in the central Amazon basin, from western to eastern Brazil.

Notes. *Palicourea virens* is characterized by its opposite to usually verticillate, well-developed, shortly petiolate leaves; its truncate to undulate or very shortly bilobed stipules; its pedunculate corymbiform inflorescences with the flowers each subtended by several linear bracts 3–15 mm long; its corollas with the characteristic tubular swollen form of *Palicourea* sect. *Corymbiferae*; and its fruits with five pyrenes. *Palicourea virens* includes some rather notable morphological variation, which appears to be continuous within a single species but may be worth evaluating in more detail with field observations. In particular, the leaves vary from obtuse at the base on developed petioles to rounded or truncate and subsessile; the plants in a local area seem to have a generally consistent leaf form, but the forms found on plants of different areas apparently intergrade over the range of the species. The bracts also vary notably in size, from rather short (3–5 mm long) to consistently longer (10–15 mm), with the size consistent on a given plant and apparently not correlated with developmental stage or locality. The full range of bract size is documented on plants with mature flowers from the small area of the Ducke Reserve in Manaus (e.g., *Prance et al. 14732*, MO, *Azevedo et al. 7947*, MO); thus, this character seems variable and apparently does distinguish local, much less regional populations. When *Pal. virens* is circumscribed to include this full range of bract size, *Pal. quinata* cannot be distinguished from it. As noted above, this species belongs to *Palicourea* sect. *Corymbiferae*.

II. Palicourea subg. **Montanae** C. M. Taylor.

6. Palicourea albocaerulea C. M. Taylor, Syst. Bot. Monogr. 26: 15, fig. 3C, D. 1989. TYPE: Costa Rica. Puntarenas: Monteverde Cloud Forest Reserve, Nuboso trail, 1540–1620 m, 16 Sep. 1983, *W. H. Busby 107* (holotype, DUKE!).

Habitat and distribution. This species is found in wet premontane forest in Central America, at 1000–1700 m in the Cordillera de Tilarán in northern Costa Rica (Alajuela, Guanacaste, and Puntarenas) and at 1684–1900 m in Honduras (Cortés).

Notes. *Palicourea albocaerulea* was reported by Taylor (2012) only from northern Costa Rica, but additional specimens (cited below) now document its distribution in Honduras. *Palicourea albocaerulea* is

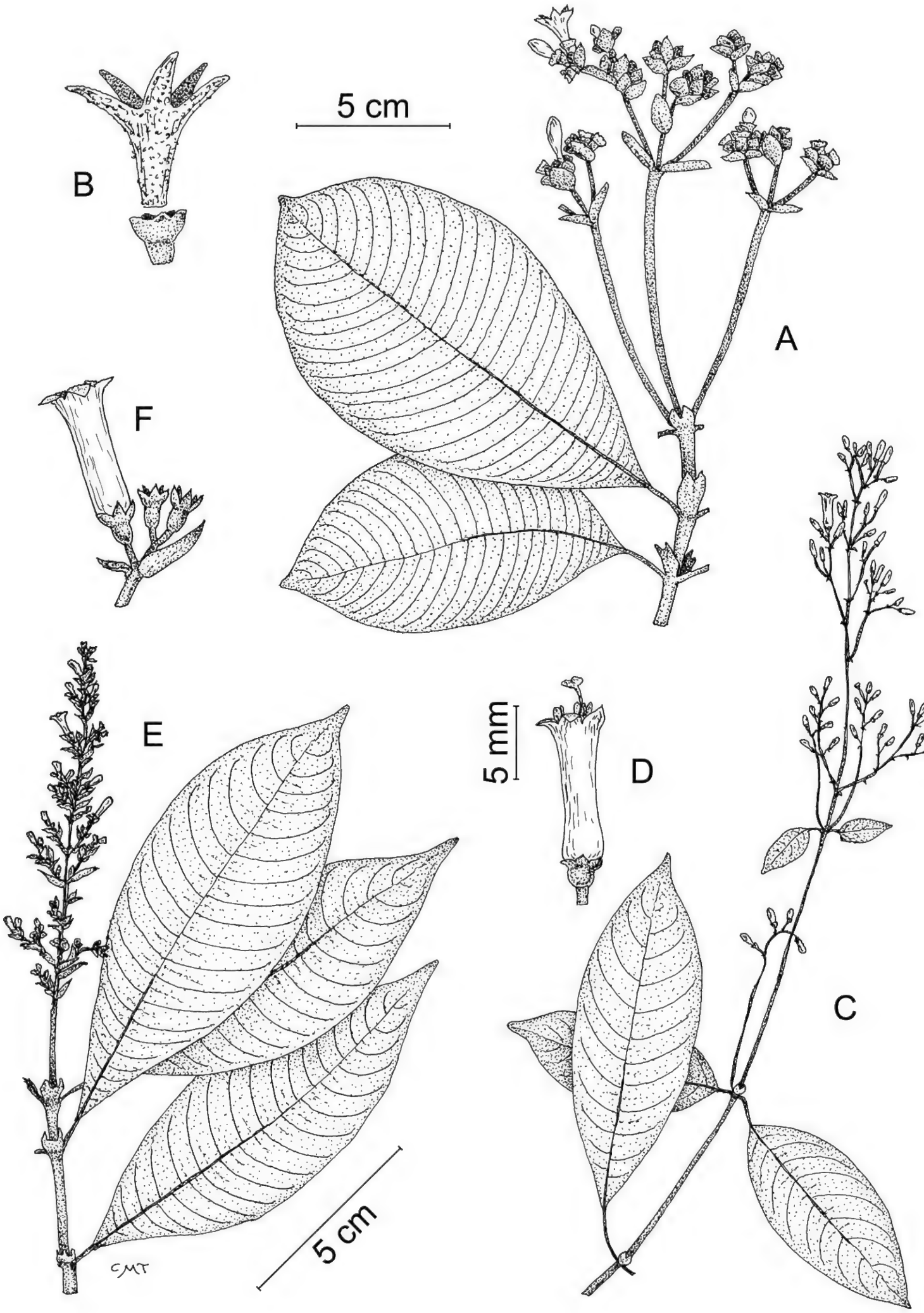

Figure 3. A, B. *Palicourea lozanoana* C. M. Taylor. —A. Flowering branch. —B. Flower at anthesis, partially dissected. C, D. *Palicourea parrana* C. M. Taylor. —C. Flowering branch. —D. Flower at anthesis. E, F. *Palicourea hondurensis* C. M. Taylor. —E. Flowering branch. —F. Portion of inflorescence with one flower at anthesis and two flowers from which corollas have fallen. A, B based on *F. R. Fosberg 19130* (US); C, D based on *O. Haught 6064* (COL); E based on *D. Mejía 445* (MO); F based on *R. L. Liesner 26588* (MO). Scale bars: A, C, E = 5 cm; B, D, F = 5 mm.

characterized by reproductive characters that include its paniculiform but narrowly pyramidal to cylindrical inflorescences with short secondary axes and well-developed bracts, its pedicellate flowers with medium-sized tubular-funnelform corollas, its ovoid fruits that are initially rounded then become weakly laterally flattened, and its calyx limbs with narrowly triangular to narrowly ligulate, acute lobes. The calyx lobes vary from 3 to 9 mm long in *Pal. albocaerulea*, but this overall measurement is not entirely descriptive because a characteristic of this species is that its calyx lobes enlarge markedly after anthesis, as the fruits develop. The inflorescence form and color and the corolla color also change as the flowers develop. As flowering starts the inflorescence axes are first ascending and closely set to the primary axes, so the overall inflorescence form is cylindrical; but later during fruiting the axes spread to produce a laxer pyramidal form. The inflorescences of the Costa Rican plants range from pale green to pale blue in flower and apparently become green again in fruit. The corollas of the Costa Rican plants are white or very pale blue when they first open and then turn clear blue with age. The Honduran plants differ a little from the Costa Rican plants in their leaves with sometimes more numerous secondary veins (11 to 15 pairs vs. nine to 12 pairs in the Costa Rican plants), their sometimes shorter calyx lobes (3–4 mm long at anthesis vs. 3.5–4 mm long in the Costa Rican plants), and their deep blue inflorescences and corollas. The Honduran plants are geographically disjunct from the Costa Rican populations, but the plants of these two countries are not otherwise distinct morphologically and therefore are not separated taxonomically here. *Palicourea albocaerulea* belongs to *Palicourea* subg. *Montanae* sect. *Montanae* ser. 4 subser. f (Taylor, 1997).

Palicourea albocaerulea is similar to *Pal. hondurensis* C. M. Taylor, which is described later in this article; see the comments under *Pal. hondurensis* for their distinctions.

Representative specimens examined. HONDURAS. **Cortés:** W of San Pedro Sula, Parque Nacional El Cusuco, Sierra de Merendón, along trail NE from El Danto camp, *A. C. Dietzsch 14136* (MO); at Cantiles camp, *A. C. Dietzsch 14176* (MO).

7. Palicourea betancuriana C. M. Taylor, sp. nov. TYPE: Colombia. Antioquia: Mpio. Frontino, Km. 17 of rd. Nutibara–Murrí, 6°45′N, 76°24′W, 1750 m, 24 Sep. 1987, *J. L. Zarucchi, A. E. Brant & C. J. Castaño 5740* (holotype, HUA-43855 image!; isotype, MO-04641187!). Figure 1C–F.

Diagnosis. *Palicourea betancuriana* C. M. Taylor is distinguished from *Pal. standleyana* C. M. Taylor by its longer calyx limb and purple corollas.

Shrubs flowering at 1 m, to 2 m tall; stems densely hirsute with trichomes 1–2.5 mm, quadrangular. Leaves opposite; blades elliptic, 8–12.5 × 2.5–6 cm, at base acute to obtuse, at apex acuminate with tips 10–12 mm, drying papery to chartaceous, both surfaces hirsute with trichomes mostly or all borne on veins; secondary veins 10 to 16 pairs, looping to interconnect near margins or extending to unite with margins, without domatia, with 1 short to well-developed intersecondary vein between most pairs of secondary veins, adaxially costa prominulous, secondary veins plane to prominulous, and remaining venation plane to thickened, abaxially costa and secondary veins prominent and remaining venation prominulous; margins ciliate to hirsute; petioles 1–3.5 cm, hirsute; stipules united around stem, persistent, hirsute to glabrescent, with sheath truncate, 5–7 mm, becoming scarious and usually splitting in intrapetiolar portion, in interpetiolar portion with triangular cartilaginous central section, this extending at top into a spatulate lobe or limb, this limb 5–8 mm, obtuse to rounded or bilobed for up to 1/2 its length, with margins hirsute. Inflorescences terminal, subcapitate to laxly cymose, subsessile to pedunculate, hirsute, green to purple; peduncles to 1 cm; branched portion broadly rounded, 2–4 × 3.5–6.5 cm, branched to 2 to 4 orders, with 1 to 2 pairs of secondary axes; bracts narrowly triangular to lanceolate, acute, glabrous except margins densely hirsute, those subtending secondary axes 10–20 mm, those subtending flowers 6–9 mm; pedicels to 1.5 mm. Flowers sessile and pedicellate in congested dichasial cymes of 3 to 5, distylous; hypanthium obconic, hirsute to glabrous; calyx limb glabrous, 5–7 mm, 5-lobed for 2/3 to almost completely, lobes narrowly triangular to lanceolate, 4–7 mm, subequal or unequal by up to 1/3 on an individual flower, acute, with margins densely hirsute; corolla funnelform, purple, externally hirsute in upper 1/2 and glabrous in lower 1/2, tube ca. 15 mm, ca. 1.5 mm diam., weakly swollen at base, straight at base and straight to curved along its length, internally glabrous except with densely pilosulous ring ca. 1 mm wide situated ca. 4 mm above base, lobes 5, narrowly triangular, ca. 4 mm, acute and plane at tip, abaxially smooth; anthers in short-styled form ca. 3 mm, partially included, situated in corolla throat, in long-styled form ca. 2 mm, included, positioned above middle of corolla tube; stigmas linear, ca. 1.5 mm, in short-styled form included and positioned above middle of corolla tube, in long-styled form exserted. Infructes-

cences similar to inflorescences or becoming displaced to pseudoaxillary by subsequent stem growth, purple; fruit narrowly ellipsoid, ca. 6 × 3 mm, weakly laterally flattened, glabrous, color unknown; pyrenes 2, hemispherical, abaxially with 4 or 5 rounded longitudinal ridges, adaxially plane or with shallow median furrow. [*Palicourea* subg. *Montanae* sect. *Montanae* ser. 4 subser. f]

Habitat, distribution, and phenology. *Palicourea betancuriana* is found in wet montane forest at 1600–2000 m in northwestern Colombia, in the northernmost portion of the Cordillera Occidental of the Andes; it has been collected in flower in January, February, and September, and with immature fruit in April.

Notes. *Palicourea betancuriana* is characterized by its hirsute pubescence, stipules with well-developed tubular sheaths that are sparsely pubescent to glabrescent, sessile or fasciculate corymbiform-rounded inflorescences, well-developed narrowly lanceolate bracts and calyx lobes, and tubular-funnelform purple corollas. This elegant species is native to the mountains of Antioquia Department, Colombia. Its name honors Dr. Julio Betancur of the Institute of Natural Sciences of the National University of Colombia, who has explored the flora of Andean Colombia and contributed to our understanding of it with extensive exploration and the training of numerous students.

Palicourea betancuriana is similar to *Pal. standleyana* and *Pal. sanchezii* (C. M. Taylor) C. M. Taylor. These species are all found in the same general region and all have abundant hirsute or pilose pubescence, similar leaf and stipule form, well-developed bracts and calyx limbs, and well-developed tubular-funnelform corollas. *Palicourea standleyana* and *Pal. sanchezii* can both be separated by their white to yellow corollas and usually ovate to elliptic calyx lobes. Additionally, *Pal. standleyana* can be separated by its inflorescences that are branched to three to four orders with well-developed axes along with its shorter calyx limbs 3–4.5 mm long, while *Pal. sanchezii* can be separated by its inflorescences with the flowers borne in three subcapitate groups, each of which is borne on a well-developed axis or peduncle, and its triangular to usually ovate calyx lobes.

Paratypes. COLOMBIA. **Antioquia:** Mpio. Frontino, correg. Nutibara, vereda Alto de Cuevas, Quebrada del Oso, *R. Fonnegra & Curso Taxonomía Vegetal 3510* (HUA n.v., MO); cuenca alta del río Cuevas, camino a Finca Llanos del Rapadal, *D. Sánchez, C. Orrego, S. Sylva, G. Martínez & D. Restrepo 879* (MEDEL n.v., MO); Mpio. Urrao, correg. La Encarnación, vereda Calles, Parque Natural Nacional Las Orquídeas, camino Calles–La Encarnación, entre confluencia ríos Polo y Calle y río San Pedro, La Quebra, *P. Pedraza-Peñalosa, J. Betancur, M. F. González, G. Giraldo, F. Gómez, A. Duque & A. Serna 2089* (COL, MO, NY n.v.).

8. Palicourea ceriantha (K. Schum.) C. M. Taylor, comb. nov. Basionym: *Rudgea ceriantha* K. Schum., Verh. Bot. Vereins Prov. Brandenburg 47: 190. 1905. TYPE: Peru. San Martín: Cerro de Escaler [sic; Escalera], 1200 m, Jan. 1903, *E. Ule 6677* (holotype, B†, B† as photo F neg. 657 in MO-1695569!; lectotype, designated here by Delprete & C. M. Taylor, HBG [barcode] 521051 image!).

Palicourea clerodendroides C. M. Taylor, Novon 10(1): 80, fig. 2A–C. 2000, syn. nov. TYPE: Ecuador. Zamora-Chinchipe: canton Nangaritza, Río Nangaritza, Pachicutza, 04°07′S, 78°37′W, 900 m, 3 Dec. 1990, *W. Palacios & D. Neill 6471* (holotype, MO-4328758!).

Habitat and distribution. *Palicourea ceriantha* is found in wet forest at 850–1200 m from southern Ecuador through central Peru, sometimes or perhaps often on sandstone substrates.

Notes. Both Schumann (1905) and Standley (1936) commented that *Rudgea ceriantha* had several unusual morphological features for its genus. Standley (1936: 162) suggested this species probably belonged to *Psychotria* but stated that it was not well enough known to confirm this. Our knowledge of the flora of Andean Peru has improved greatly since then, and the type photo of *R. ceriantha* can now be seen to match the plants that were described as *Palicourea clerodendroides*. The identity and characters of *Pal. clerodendroides* and thus of *Pal. ceriantha* were outlined by Taylor (2000). This species belongs to *Palicourea* subg. *Montanae* sect. *Montanae* ser. 4 subser. f.

The name *Rudgea ceriantha* was based on a single specimen at B, which has been destroyed. The photograph of this specimen is adequate to confirm the identity of the name, but a new type is needed. The main set of Ule's specimens is deposited at HBG, and the isotype specimen there of *Ule 6677* is in good condition and chosen here as the lectotype of *R. ceriantha*.

9. Palicourea foreroi C. M. Taylor, sp. nov. TYPE: Colombia. Chocó: carretera Ansermanuevo–San José del Palmar, límite con el Valle del Cauca, Alto del Galápago, 2000 m, 18 Feb. 1977, *E. Forero, A. Gentry, A. Sugden & D. Daly 2899* (holotype, COL-195401!; isotype, MO-2594400!). Figure 2E, F.

Diagnosis. *Palicourea foreroi* C. M. Taylor is distinguished from *Pal. lasiorrhachis* Oerst. and *Pal. pyramidalis* Standl. by its inflorescences with longer pedicels and its longer corollas, and from *Pal. pyramidalis* also by its corollas that are generally straight at the base.

Subshrubs, shrubs, and small trees flowering at 1.2 m tall, to 3 m tall; stems glabrous, quadrangular to subterete or somewhat flattened. Leaves opposite; blades elliptic to narrowly elliptic, 6–13.5 × 1.3–5.5 cm, at base acute to cuneate, at apex acuminate with slender tips 0.5–1.7 cm, drying papery, adaxially glabrous, abaxially glabrous or sometimes sparsely to moderately strigillose on veins; secondary veins 7 to 10 pairs, weakly looping to interconnect near margins or often extending to eventually unite with margins, without domatia, with 1(2) short intersecondary vein(s) between pairs of secondary veins, adaxially and abaxially costa prominent and secondary and higher-order venation prominulous; margins entire (i.e., glabrous); petioles 0.8–3 cm, glabrous to sparsely strigillose; stipules persistent, laminar (i.e., interpetiolar), glabrous, on each interpetiolar side with unlobed basal portion 1–2 mm, with lobes 2, triangular to lanceolate, 2–9 mm, acute, entire to shortly erose, separated by concave sinus. Inflorescences terminal, laxly paniculiform, pedunculate or apparently sessile and tripartite, glabrous or puberulous, yellow to orange, reddish orange, or red; peduncles 0.8–2.8 cm; branched portion pyramidal, 4.5–21 × 3–18 cm, branched to 2 or 3 orders, with 3 to 5 pairs of secondary axes; bracts narrowly ligulate to narrowly triangular, acute, glabrous, those subtending secondary axes 1.5–8 mm, those subtending or borne along pedicels 1.2–3 mm; pedicels 3–14 mm. Flowers pedicellate in racemiform cymes of 3 to 7, distylous; hypanthium obconic to ellipsoid, 1–1.5 mm, glabrous to puberulous, yellow to bright purple or pink; calyx limb 0.8–1 mm, glabrous, 5-lobed for 2/3–3/4 of its length, yellow to purple or pink, lobes triangular to ligulate, acute to rounded; corolla tubular-funnelform, bright yellow, externally glabrous, tube 13–15 mm, 1.5–2 mm diam. near middle, symmetrically swollen to weakly gibbous at base, generally straight at base and along its length, internally glabrous except with densely pilosulous ring ca. 1.5 mm wide just below middle, lobes 5, triangular, 2–3 mm, abaxially smooth, at apex acute and plane or thickened; anthers ca. 3 mm, in long-styled form included and positioned in upper part of corolla tube, in short-styled form partially exserted; stigmas in long-styled form 0.5–1 mm and exserted, in short-styled form not seen. Infructescences similar to inflorescences; fruits obovoid, ca. 6.5 × 6 mm, laterally flattened, glabrous, blue; pyrenes 2, plano-convex, abaxially with 4 or 5 well-developed obtuse to subtruncate ridges, adaxially plane with a longitudinal, medial, T-shaped furrow. [*Palicourea* subg. *Montanae* sect. *Obovoideae* C. M. Taylor ser. 5]

Habitat, distribution, and phenology. *Palicourea foreroi* is found in wet montane forest at 1620–2300 m in western Colombia, in the western Andes in the Cordillera Occidental and the Cerro del Torrá; it has been collected in flower in January, February, July, August, and October, and with immature fruit in February.

Notes. *Palicourea foreroi* is characterized by its somewhat slender habit; laminar (i.e., interpetiolar) stipules with well-developed lobes that are usually asymmetrically broadened toward the sides by the petioles; lax, yellow to orange paniculiform inflorescences with well-developed pedicels; medium-sized yellow corollas; and obovoid fruits. Both long-styled and short-styled flowers are documented, but only one mature short-styled flower has been seen: this is on the isotype and was not dissected in order to preserve the material. This species has been found in both the main Cordillera Occidental and the associated Cerro del Torrá massif (Silverstone-Sopkin & Ramos-Pérez, 1995). Plants from the Cerro del Torrá generally have relatively broader leaves and puberulous inflorescence axes versus more narrowly elliptic leaves and glabrous axes in plants from the main Cordillera Occidental; otherwise, these populations are not separable morphologically. *Palicourea foreroi* is found in scattered montane localities on the Pacific slopes of western Colombia, including the area of San José del Palmar in southern Chocó Province. This area was explored botanically by Dr. Enrique Forero, who collected the type specimen, and the specific epithet honors him.

Palicourea foreroi is similar in general aspect, in inflorescence and flower color, and especially in stipule and fruit form to *Pal. lasiorrhachis*, an infrequently collected species in western Colombia; *Pal. lasiorrhachis* can be separated in this region by its hirtellous stems and inflorescence axes, its mostly shorter pedicels 1–6 mm long, and its shorter corollas with tubes 8–10 mm long. (*Palicourea lasiorrhachis* is common and shows wider morphological variation in Central America, where its corolla tubes range up to 16 mm long, but this species is less variable morphologically in South America.) *Palicourea foreroi* is also similar to *Pal. pyramidalis*, which is rather commonly collected in western Colombia; *Pal. pyramidalis* can be separated by its more broadly elliptic leaves 4.5–10 cm wide, its inflorescences with generally shorter pedicels 1–8 mm long, and its

corollas that are markedly swollen and bent at 45°–90° at the base and have shorter tubes 8–12 mm long.

Paratypes. COLOMBIA. **Cauca:** vereda La Romelia, Parque Nacional Munchique, El Tambo, camino de Nueva Granada, *F. González, C. Acevedo, C. Barbosa, G. Lozano, M. A. Martín, E. Rico, N. Ruiz, C. Urones & M. Velayos 2977* (COL 2 sheets); rd. from Timbío to Veinte de Julio, Km. 54, *P. J. M. Maas & T. Plowman 2107* (COL). **Chocó:** Mpio. San José del Palmar, vereda El Corcovado, Finca La Esperanza, *S. Díaz P. 3713* (COL); Finca Ayaconas, *P. Franco, O. Rangel, A. Cleef & S. Salamanca 1589* (COL 2 sheets, MO); vereda Río Negro, Cerro del Torrá, vertiente oriental, abajo del helipuerto hasta el agua que baja del Cerro, *J. E. Ramos, P. A. Silverstone-Sopkin, L. H. Ramos, et al. [sic] 1585* (CUVC n.v., MO); vertiente nordeste, *P. A. Silversotne-Sopkin 1346* (CUVC n.v., MO 2 sheets). **Valle del Cauca:** Mpio. El Cairo, along rd. to San José del Palmar, ca. 2 km before Chocó-Valle limit, *C. M. Taylor, W. Devia & J. Adarve 12044* (MO, TULV).

10. Palicourea hondurensis C. M. Taylor, sp. nov. TYPE: Honduras. Yoro: Río Pijol valley, 6–7 km S of Nueva Esperanza, 15°12′N, 87°35′W, 1570–1670 m, 27 May 1993, *R. L. Liesner 26588* (holotype, MO-04591620!; isotype, EAP!). Figure 3E, F.

Diagnosis. *Palicourea hondurensis* C. M. Taylor is distinguished from *Pal. albocaerulea* C. M. Taylor by its shorter calyx lobes and usually longer stipule lobes, and from *Pal. brenesii* Standl. by its cylindrical to very narrowly pyramidal inflorescences, usually longer bracts, and laterally flattened fruits.

Shrubs and small trees flowering at 1 m tall, to 2 m tall; stems glabrous, quadrangular. Leaves opposite; blades elliptic to elliptic-oblong, 8–20 × 3–6.5 cm, at base acute to cuneate, at apex acuminate with tips 5–10 mm, drying papery, adaxially glabrous, abaxially glabrous except hirtellous to hirsute along costa and sometimes puberulous to pilosulous on secondary veins; secondary veins 13 to 18 pairs, weakly looping near margins or weakly extending to unite with margin, without domatia, without or usually with 1 weak intersecondary vein present between each pair of secondary veins, adaxially costa thinly prominulous and remaining venation plane to thickened, abaxially costa prominent, secondary venation prominulous, and higher-order venation plane to prominulous; margins entire; petioles 0.7–1.8 cm, glabrous; stipules persistent, united around stem, glabrous, sheath truncate, 2–4 mm, lobes 2 on each interpetiolar side, narrowly triangular to narrowly ligulate, 3–6 mm, acute, entire. Inflorescences terminal, laxly paniculiform, pedunculate, hirtellous to glabrous, light to deep blue; peduncle 2–3.5 cm; branched portion cylindrical to narrowly pyramidal, 8.5–13.5 × 2.5–4 cm, branched to 2 or 3 orders, with 8 to 10 pairs of developed secondary axes; bracts narrowly triangular to narrowly ligulate, hirtellous to glabrous, obtuse to acute, ciliolate, those subtending secondary axes 5–12 mm, those subtending pedicels 3–6 mm; pedicels 0.5–7 mm. Flowers pedicellate in dichasial cymes of 3 to 7, whether distylous or homostylous unknown; hypanthium cylindrical, 1–1.2 mm, glabrous; calyx limb glabrous, 5-lobed nearly to base, lobes narrowly ligulate to lanceolate, 1–2 mm, subequal or unequal by up to 50% on an individual flower, obtuse to acute; corolla tubular to tubular-funnelform, white, externally glabrous or sometimes hirtellous on lobes, tube 11–14 mm, 1.8–2.5 mm diam. near middle, somewhat symmetrically swollen at base, generally straight at base and along its length, internally glabrous except with densely pilosulous ring ca. 1 mm wide situated 1.5–2 mm above base, lobes 5, triangular, 1.8–2 mm, abaxially smooth, at apex acute and plane to weakly thickened; anthers ca. 2.2 mm, included, situated near middle of corolla tube; stigmas linear, ca. 1 mm, exserted. Infructescences similar to inflorescences or becoming more lax; fruits ovoid, ca. 4.5 × 4.5 mm, laterally somewhat flattened, glabrous, mature color unknown; pyrenes 2, planoconvex, abaxially with 4 or 5 rounded longitudinal ridges, adaxially plane with a medial longitudinal furrow. [*Palicourea* subg. *Montanae* sect. *Montanae* ser. 3 subser. c]

Habitat, distribution, and phenology. *Palicourea hondurensis* is found in wet premontane forest at 1500–1740 m in Central America, in central to eastern Honduras; it has been collected with flowers in May and June, and with immature fruits in March.

Notes. *Palicourea hondurensis* is characterized by its stipules with a truncate sheath and two narrow lobes on each interpetiolar side; its pedunculate, paniculiform, blue inflorescences that are cylindrical to narrowly pyramidal in outline; its rather short calyx lobes; its medium-sized tubular to tubular-funnelform white corollas; and its ovoid fruits that are laterally somewhat flattened. All the flowering specimens seen resemble the long-styled form of distylous *Palicourea* species, but this species is not well documented and whether it is distylous or not cannot yet be determined. This new species is known only from Honduras, and the species epithet refers to this distribution. The premontane forests of Honduras are not well explored botanically, but this species has been documented from several separated localities and thus appears fairly widely distributed in that country.

Palicourea hondurensis is similar to several other Central American species of *Palicourea*, which share

similar stipule and leaf form, inflorescence arrangement, and corolla and fruit size and shape. *Palicourea hondurensis* is similar in particular to *Pal. albocaerulea*, which is also found in Honduras as discussed above; *Pal. albocaerulea* can be separated by its generally shorter stipule lobes (1.5–4 mm long) and its longer calyx lobes (3.5–9.5 mm long). Also similar to *Pal. hondurensis* is *Pal. lancifera* Standl. & L. O. Williams of northern Costa Rica; *Pal. lancifera* can be separated by its green inflorescences with shorter bracts (1.5–3.5 mm) subtending the pedicels, its usually longer calyx lobes (1.5–3 mm long), its generally shorter corollas with tubes 8–11 mm long, and its globose (i.e., not flattened) fruits. Also similar to these is *Pal. leucantha* Donn. Sm. of southern Mexico and Guatemala; *Pal. leucantha* can be separated by its more broadly pyramidal, green or yellowish green inflorescences with their branched portions 7.5–10 cm wide and its shorter corollas with tubes ca. 10 mm long. *Palicourea hondurensis* can also be confused with *Pal. brenesii* of southern Costa Rica, and specimens of *Pal. hondurensis* may key to *Pal. brenesii* in existing keys to Central American *Palicourea* (Taylor, 1989, 2012). However, *Pal. brenesii* can be separated by its usually longer stipule sheath (3–6 mm long), its more broadly pyramidal inflorescences with the branched portion 4–9.5 cm wide, its pedicels mostly subtended by shorter bracts (2–4 mm long), its usually longer calyx lobes (1.8–2.5 mm long), its globose (i.e., not flattened) fruits, and its habitat in montane forest at 1900–3200 m.

Paratypes. HONDURAS. **Comayagua:** ridge of Cerro El Maneadero, ca. 11 km of Lake Yojoa, Parque Nacional Azúl Meámbar, *R. Evans 1350* (MO). **Olancho:** La Muralla Natl. Park, 8 km NNW of La Unión, *T. Hawkins & D. Mejía 499* (MO). **Yoro:** Campamento Río Pijol, 6.2 km al SE de Nueva Esperanza, Parque Nacional Pico Pijol, *D. Mejía 445* (MO).

11. Palicourea kahirica C. M. Taylor, sp. nov. TYPE: Colombia. Valle del Cauca: Mpio. El Cairo, Cerro del Inglés, Cordillera Occidental, Serranía de los Paraguas, a 1 hora en jeep de El Cairo, vertiente sur, 2260 m, 5 Jan. 1987, *P. A. Silverstone-Sopkin, N. Paz, R. T. González, I. Cabrera, D. Garcés & A. Henao 2963* (holotype, CUVC-24648!; isotype, MO-05006422!). Figure 2A, B.

Diagnosis. *Palicourea kahirica* C. M. Taylor is distinguished from *Pal. lehmannii* (K. Schum. & K. Krause) Standl. by its shorter corollas with the lobes abaxially thickened but not horned, and from *Pal. stipularis* Benth. and *Pal. amethystina* (Ruiz & Pav.) DC. by its longer corollas that are tapered at the top in bud and its seeds with a broad, rounded, longitudinal furrow on the adaxial face.

Shrubs and small trees flowering at 2 m tall, to 5 m tall; stems glabrous, quadrangular sometimes becoming subterete with age. Leaves opposite; blades elliptic, 6–20 × 1.8–7 cm, at base acute to cuneate, at apex acuminate with tips 10–20 mm, drying papery, adaxially glabrous, abaxially sparsely strigillose on costa and secondary veins and sometimes also on lamina; secondary veins 13 to 16 pairs, weakly looping to interconnect near margins, without domatia, with 1(2) short intersecondary vein(s) between pairs of secondary veins, adaxially costa prominent, secondary veins plane to usually prominulous, and remaining venation plane or occasionally thickened, abaxially costa prominent and secondary and remaining venation prominulous; margins entire to strigillose; petioles 1–2.3 cm, glabrous; stipules persistent, glabrous, united around stem or with interpetiolar portion of sheath reduced, sheath 1.5–4 mm, truncate, lobes 2 on each interpetiolar side, deltate to narrowly triangular, 1–2.5 mm, acute, entire to sparsely ciliolate. Inflorescences terminal, laxly paniculiform, pedunculate or often apparently sessile and tripartite, glabrous to puberulous, blue; peduncles 2.5–3.5 cm; branched portion pyramidal, 8–16 × 8–14 cm, branched to 3 orders, with 3 to 7 pairs of secondary axes; bracts ovate to lanceolate, acute to obtuse, glabrous, those subtending secondary axes 1–5 mm, those subtending or borne along pedicels 1–1.5 mm; pedicels 2–9 mm. Flowers pedicellate on racemiform axes, whether distylous or homostylous unknown; hypanthium cylindrical, 1–1.8 mm, glabrous; calyx limb glabrous, 1–1.2 mm, 5-lobed for 2/3–3/4 its length, lobes deltate, entire; corolla tubular-funnelform, pale blue, externally glabrous, in bud somewhat inflated and tapered at the top, at maturity with tube 16–23 mm, 2–2.5 mm in diam. near middle, swollen somewhat asymmetrically at base, generally straight at base and along its length, internally glabrous except with densely pilosulous ring ca. 3 mm wide just below middle of tube, lobes 5, triangular, ca. 3 mm, acute, abaxially thickened near apex, at apex acute and plane or usually thickened; anthers 4–4.5 mm, included, positioned in upper part of corolla tube; stigmas ca. 0.5 mm, exserted. Infructescences similar to inflorescences; fruits ovoid to ellipsoid, ca. 5.5 × 5 mm, glabrous, mature color unknown; pyrenes 2, hemispherical, abaxially with 4 or 5 rounded ridges, adaxially plane with medial line over a broad rounded longitudinal furrow in seed. [*Palicourea* subg. *Montanae* sect. *Montanae* ser. 4 subser. e]

Habitat, distribution, and phenology. *Palicourea kahirica* is found in wet montane forest at 1620–2100 m on the Pacific slopes of Colombia, in the western

Andes in the Cordillera Occidental and the Cerro del Torrá; it has been collected in flower in January and October, and with immature fruits in January and August.

Notes. *Palicourea kahirica* is characterized by its stipules that are united around the stem into a truncate sheath with two triangular lobes on each side; its pedunculate, laxly paniculiform, pyramidal inflorescences with rather small bracts and well-developed pedicels; its medium-sized, tubular-funnelform blue corollas that are somewhat inflated and tapered apically in bud and have rounded abaxial thickenings on the lobes; and its subglobose fruits with hemispherical, longitudinally ribbed pyrenes containing seeds with a broad rounded abaxial furrow. *Palicourea kahirica* is so far documented only from a relatively small range on the Pacific slopes of the mountains of western Colombia, which includes the municipality of El Cairo; the species epithet refers to this locality. This species has been found in both the main Cordillera Occidental and the separated massif of the Cerro del Torrá (Silverstone-Sopkin & Ramos-Pérez, 1995). Only three collections of this new species have mature flowers, which are all similar to the long-styled form of distylous *Palicourea* species; more material will be needed to confirm if *Pal. kahirica* is distylous or not.

Palicourea kahirica is similar to *Pal. lehmannii*, which is known from a small area just south of the range of *Pal. kahirica*. *Palicourea lehmannii* differs from *Pal. kahirica* in its longer corollas, with tubes 23–25 mm long, that have unusual well-developed appendages or horns 2–4 mm long on the abaxial surfaces of the lobes. *Palicourea kahirica* is also similar to *Pal. stipularis* and *Pal. amethystina*, which are also found in montane forests in western Colombia. *Palicourea stipularis* and *Pal. amethystina* can both be separated by their shorter corollas, with tubes 10–14 mm long, that are truncate at the top in bud and by their seeds that are abaxially plane except for a narrow, acute, longitudinal groove.

Paratypes. COLOMBIA. **Chocó:** Mpio. San José del Palmar, vereda Corcovados, Finca La Esperanza, *S. Díaz P. 3717* (COL 2 sheets); vereda río Negro, Cerro del Torrá, vertiente oriental, abajo del helipuerto hasta el agua que baja del Cerro, *J. E. Ramos, P. A. Silverstone-Sopkin, L. H. Ramos, et al. [sic] 1594* (MO); SW of El Cairo along rd. from Valle-Chocó limit to Finca la Florida, ca. 8 km from limit on rd. to río Blanco, *C. M. Taylor, W. Devia & J. Adarve 12012* (MO, TULV); ca. 5 km from limit, at school, *C. M. Taylor, W. Devia & J. Adarve 12035* (MO, TULV). **Valle del Cauca:** Mpio. El Cairo, Cerro del Inglés Cordillera Occidental, Serranía de los Paraguas, a 1 hora en jeep de El Cairo, *P. A. Silverstone-Sopkin, N. Paz, R. T. González, I. Cabrera & D. Garcés 2725* (CUVC); along rd. to San José del Palmar, ca. 2 km before Chocó-Valle limit, *C. M. Taylor, W. Devia & J. Adarve 12043* (MO, TULV); vereda El Brillante, Res. Nat. La Fontana, Cordillera Occidental, Serranía de Los Paraguas, *D. Montoya-Dossman & M. Rentería 105* (CUVC).

12. Palicourea lozanoana C. M. Taylor, sp. nov. TYPE: Colombia. Norte del Santander: Mpio. Chitagá, correg. Chucarima, hills E of Río Valegrá, S of Quebrada Valegrá, 2000 m, 16 Nov. 1942, *F. R. Fosberg 19130* (holotype, US-2108081!). Figure 3A, B.

Diagnosis. *Palicourea lozanoana* C. M. Taylor is distinguished from *Pal. denslowiae* J. H. Kirkbr. by its leaves with the tertiary venation not or only sparsely reticulated, its laminar stipules with the lobes separated by an acute to concave sinus, its shorter calyx limbs, and its corollas without abaxial appendages or horns.

Shrubs and small trees flowering at 3 m tall, to 6 m tall; stems quadrangular, glabrous. Leaves opposite; blades elliptic to obovate, 10–19.2 × 4–8.5 cm, at base acute to cuneate, at apex acuminate with tips 10–15 mm, drying papery to chartaceous, adaxially shiny and glabrous or densely hirtellous on costa and secondary veins, abaxially moderately to densely strigillose on costa and secondary veins and glabrous to sparsely strigillose on lamina; secondary veins 24 to 27 pairs, extending to reticulate or looping to interconnect weakly near margins, without intersecondary veins, without domatia, with tertiary venation not or sparsely reticulated and usually extending perpendicularly to connect pairs of secondary veins, adaxially costa and secondary veins prominulous and remaining venation plane or weakly impressed, abaxially costa and secondary veins prominent and remaining venation plane; petioles 1–2.2 cm, puberulous; stipules persistent, laminar, glabrous, in outline ovate, with unlobed basal portion 4–10 mm, with lobes 2, triangular, 1–4 mm, acute, with margins membranaceous to weakly erose, separated by acute to concave sinus. Inflorescences terminal, paniculiform, pedunculate or apparently sessile and tripartite, strigillose to shortly hirtellous, color at anthesis not noted; peduncle 2–8 cm; branched portion broadly pyramidal to broadly corymbiform, 7–14 × 2–8 cm, branched to 2 or 3 orders, with 2 pairs of secondary axes; bracts glabrous, entire to usually densely ciliolate, those subtending secondary axes foliaceous or ligulate, 12–20 mm, obtuse to acute, those subtending flowers or flower groups ligulate to elliptic or ovate, 4–10 mm, rounded to obtuse. Flowers sessile and subsessile in glomerules or congested cymes of 5 to 7, whether distylous or homostylous unknown; hypanthium obconic, ca. 1 mm, glabrous; calyx limb 2–3 mm, glabrous, truncate to shallowly undulate, densely ciliolate; corolla funnelform, pur-

ple, externally densely puberulous throughout or sometimes glabrous in basal 1/3, tube ca. 10 mm, ca. 2 mm diam. near middle, swollen and gibbous at base, apparently straight at base and along its length, internally glabrescent except sparsely hirtellous near middle, lobes 5, narrowly triangular, ca. 6 mm, abaxially smooth, at apex acute and plane; anthers ca. 4 mm, included, positioned near middle of corolla tube; stigmas ca. 1 mm, exserted. Infructescences similar to inflorescences; fruits ellipsoid to obovoid, 6–8 × 6–7 mm, glabrous, mature color not noted; pyrenes 2, hemispherical, abaxially with 5 or 6 well-developed sharp ridges, adaxially plane on outer surface but this wall internally with well-developed acute medial ridge. [*Palicourea* subg. *Montanae* sect. *Psychotrioides* C. M. Taylor ser. 9]

Habitat, distribution, and phenology. *Palicourea lozanoana* is found at 2000–2200 m in the Cordillera Oriental of Colombia; it has been collected in bud in October, in flower in November, and with well-developed fruits in June and October.

Notes. *Palicourea lozanoana* is characterized by its leaves with rather numerous secondary veins and unusual overall venation pattern; its laminar stipules with the broad lobes closely set; its corymbiform inflorescences with the flowers sessile or subsessile in several glomerules or heads that are enclosed by well-developed, rounded or obtuse bracts; its medium-sized funnelform purple corollas; and its ellipsoid fruits. The leaf venation of this new species is unusual in *Palicourea* in its regularly spaced tertiary veins that extend to connect the secondary veins mostly without reticulating, and its general lack of evident intersecondary veins. In most species of *Palicourea* the tertiary venation is reticulated to form areoles and usually also connects between pairs of secondary veins in a short intersecondary vein. Venation that is generally similar to that of *Pal. lozanoana* is found in a few other *Palicourea* species, e.g., *Pal. densa* Standl. and *Pal. harlingii* C. M. Taylor, though in these other species the tertiary veins do reticulate at least once between each pair of secondary veins. This elegant unusual species is named in honor of Prof. Gustavo Lozano Contreras (1938–2000), who documented and studied the Colombian flora, in particular Magnoliaceae and Melastomaceae, and collected this new species. Only one collection, the type, has well-preserved flowers that clearly belong with the inflorescence; these flowers resemble the long-styled form of distylous *Palicourea* species but whether *Pal. lozanoana* is distylous cannot yet be determined. A second, poorly preserved corolla is present on the specimen *Lozano et al. 911*, and this appears to belong to this species and resembles short-styled flowers. However, this corolla is separate from the rest of the specimen, and as the inflorescence on this specimen is immature and the label data do not mention flowers, this corolla may not be from this plant.

Palicourea lozanoana is similar to *Pal. denslowiae* of montane forests in Antioquia in northwestern Colombia; *Pal. denslowiae* can be separated by its leaves with fewer secondary veins (10 to 12 pairs) and the tertiary venation reticulating between each pair of secondary veins, its stipules that are united around the stem and have the lobes narrowly separated by a truncate sinus, its longer calyx limbs 5–7 mm long, and its corollas with fleshy conical appendages or horns 3–5 mm long on the abaxial surfaces of the lobes. *Palicourea lozanoana* is also similar to *Pal. eburnea* C. M. Taylor, which is also found in montane forests in the Cordillera Oriental of Colombia; *Pal. eburnea* can be separated by its stipules that are united around the stem and have the lobes separated by a truncate sinus, its reticulated tertiary venation, and its flowers borne in lax cymes on pedicels 2–5 mm long. *Palicourea lozanoana* is also similar to *Pal. diguana* (Standl. ex Steyerm.) C. M. Taylor of Pacific western Colombia; *Pal. diguana* can be recognized by its leaves with regularly developed intersecondary veins and reticulated tertiary venation, along with its larger white corollas with tubes 35–40 mm long. *Palicourea lozanoana* has also been confused with *Pal. skotakii* C. M. Taylor of Costa Rica and Panama; *Pal. skotakii* can be separated by its leaves with fewer secondary veins (12 to 16 pairs), regularly developed intersecondary veins, and reticulated tertiary venation, along with its flowers that are enclosed by larger acute bracts 4–15 mm long.

Paratypes. COLOMBIA. **Boyacá:** Mun. Pajarito, correg. Corinto, *G. Lozano C., F. Díaz & S. Díaz P. 911* (COL); inspección de policía de Corinto, camino al salto Candelas, *A. Medina 10* (COL).

13. Palicourea murciae C. M. Taylor, sp. nov. TYPE: Colombia. Cundinamarca: carretera a Mundo Nuevo, 14 km E of La Calera, 2750 m, 18 Feb. 1972, *A. S. Barclay, P. Juajibioy & J. Gama 3188* (holotype, COL-127228!; isotype, US-2702232!). Figure 1A, B.

Diagnosis. *Palicourea murciae* C. M. Taylor is distinguished from *Pal. weberbaueri* K. Krause and *Pal. anceps* Standl. by its dense velutinous pubescence on the stems and stipules, its more numerous secondary leaf veins, and its shorter corollas.

Shrubs and small trees flowering at 1.2 m tall, to 11 m tall; stems quadrangular, densely velutinous.

Leaves opposite; blades elliptic to broadly elliptic or ovate, 12–24.5 × 6.5–15 cm, at base acute to usually broadly obtuse or subtruncate, at apex shortly acuminate with tips 3–10 mm, drying chartaceous, adaxially puberulous to pilosulous or glabrescent on lamina and densely pilosulous on costa and secondary veins, abaxially densely pilosulous throughout or glabrescent on lamina; secondary veins 18 to 25 pairs, weakly looping to interconnect near or at margins, without intersecondary veins or occasionally with 1(to 3) short intersecondary vein(s) between pairs of secondary veins, without domatia, adaxially costa prominulous and remaining venation plane or higher-order venation sometimes thinly impressed, abaxially costa and secondary veins prominent and higher-order venation prominulous; petioles 1.8–4 cm, densely velutinous to pilosulous; stipules persistent, united around stem into a continuous sheath or reduced in interpetiolar portions, densely velutinous or sometimes glabrescent with age, sheath 4–9 mm, lobes 2 per side, deltate to ligulate, 2–6 mm, acute to rounded, separated by truncate to shallowly concave sinus. Inflorescences terminal, paniculiform, pedunculate, moderately to usually densely pilosulous, yellowish green to yellow; peduncle 2–6 cm; branched portion pyramidal to somewhat cylindrical, 6–16 × 5.5–14 cm, branched to 4 or 5 orders, with 6 to 12 pairs of secondary axes; bracts triangular to narrowly triangular, densely velutinous, acute, those subtending secondary axes 4–7 mm, those subtending flowers 0.5–1 mm or sometimes ca. 0.1 mm and glandular; pedicels to 4 mm. Flowers sessile to pedicellate in dichasial cymes of 5 to 7, distylous; hypanthium ellipsoid to obconic, ca. 1 mm, pilosulous; calyx limb 1–1.2 mm, pilosulous to glabrescent, 5-lobed for 1/2–3/4 of its length, lobes triangular to ovate, acute to rounded, entire to ciliolate; corolla funnelform, sky blue to blue-green or turquoise with lobes often whitened or yellowed, externally pilosulous to glabrescent, tube 4–7 mm, 1–1.2 mm diam. near middle, markedly gibbous at base, bent just above basal swelling and curved along its length, internally glabrous except with densely pilosulous ring 1–2 mm wide near middle, lobes 5, triangular, 1.2–3.5 mm, abaxially thickened, at apex acute and thickened; anthers in short-styled form ca. 1.8 mm and partially to fully exserted, in long-styled form ca. 2 mm and included; stigmas in short-styled form ca. 2 mm, included, and positioned in upper 1/2 of corolla tube, in long-styled form ca. 1 mm and exserted. Infructescences similar to inflorescences; fruit ellipsoid to subglobose, 3.5–4.5 × 3.5–4.5 mm, weakly laterally flattened, glabrescent, blue to purple-black; pyrenes 2, hemispherical, abaxially with 4 or 5 well-developed rounded ridges, adaxially plane with medial longitudinal furrow. [*Palicourea* subg. *Montanae* sect. *Montanae* ser. 3 subser. c]

Habitat, distribution, and phenology. *Palicourea murciae* is found in montane forest at 1850–3100 m in Andean Colombia, widely in the Cordilleras Occidental and Central and at least occasionally in the Cordillera Oriental; it has been collected in flower in February, May, June, August through October, and December, and with well-developed fruits in March, May through July, October, and December.

Notes. *Palicourea murciae* is characterized by its dense velutinous pubescence on the stems and stipules, its leaves with numerous secondary veins, its rather well-developed stipules with proportionally short lobes, its relatively short corollas, its subglobose to ellipsoid fruits, and its unusual inflorescence color scheme with the axes yellowish green to yellow and the corollas sky blue to turquoise. The disk of the flower is unusual on several specimens (e.g., *Barclay et al. 3188*, *Carvajal 1316*); it is relatively large (1.5–2 mm long) with its top thickened and 4-lobed or perhaps raised into a tapered rim, rather than smooth or shallowly bilobed as in other species of *Palicourea*. However, this feature is not well preserved on dried specimens, and further study will be needed to understand this structure in this species (including whether these particular disks are galled). *Palicourea murciae* is found widely in the Andes of Colombia but has not so far been documented outside this country. This notable new species has been most commonly encountered and collected in the Cordillera Central in Caldas, Pereira, and Risaralda, and has been collected several times there by the ecologist Dr. Carolina Mucia. She has documented a number of poorly known Rubiaceae from this region, and the name of this new species honors her.

Palicourea murciae is unusual in its corollas that are darker in color than the inflorescence axes, and also in having both blue and yellow colors presented together on the inflorescence. Most species of *Palicourea* have inflorescence axes and corollas that are all either blue to purple, or all yellow to red, with the axes darker in color or tone than the corollas so the corollas appear lighter-colored against the inflorescence axes. However, in *Pal. murciae* and a few other species, the axes are yellow and the corollas blue, and these corollas appear darker against the inflorescence axes. *Palicourea murciae* is similar in this regard to two other montane species with yellow inflorescence axes and blue corollas, *Pal. anceps* of Colombia and *Pal. weberbaueri* of southern Ecuador

through southern Peru. These other two species can both be separated from *Pal. murciae* by their glabrescent to hirtellous stems and stipules, their leaves with fewer secondary veins (eight to 16 pairs), their longer corolla tubes (8–10 mm long), and their ellipsoid fruits that are generally longer than wide and laterally somewhat flattened. *Palicourea murciae* is also similar to *Pal. prodiga* Standl. ex C. M. Taylor, but *Pal. prodiga* can be separated by its hirtellous pubescence with longer trichomes, its larger stipule sheaths 8–22 mm long, its different stipule form with the angles costate and the sheath usually tardily splitting along one side into a spathaceous form, and its yellow corollas.

Paratypes. COLOMBIA. **Antioquia:** Mpio. Jardín, Alto de Ventanas, 15 km SO de Jardín en via Riosucio, *R. Callejas, O. Marulanda, F. J. Roldán & H. Correa 3896* (HUA); ca. Riosucio, *C. Maldonado, C. Persson, A. Antonelli & C. Bacon 4058* (C, MO). **Caldas:** Neira, vereda la Cristallina, *L. M. Alvarez 1368A* (MO); Manizales, vereda La Esperanza, Reserva Torre Cuatro, *M. Alvear-P., P. Franco & A. Abogal 276* (COL); ca. quebrada El Diamante abajo carr. hacía Bogotá, *M. Alvear-P., M. Sánchez, F. Sánchez & J. Pérez 611* (COL); Mpio. Murillo, La Truchera, *J. Ruiz, G. Cortés & H. Escobar 89T* (COL). **Cauca:** rd. Popayán–Huila, E edge Parque Nac. Puracé, *T. B. Croat 51879* (COL); Cordillera Central, vertiente occidental, cabeceras río Palo, quebrada Santo Domingo, *J. Cuatrecasas 19196* (US); Mpio. Silvia, reserva indígena, *G. Lozano C. 3622* (COL); Mpio. Páez-Belalcazar, Tierradentro, resguardo Mosoco, tul de Gloria Hurtado, [no initial] *Velasco V. 9* (COL). **Chocó:** Mpio. El Carmen de Atrato, carr. Urrao, ca. 15 km NO cabecera municipal, *G. Galeano, G. Lozano, C. I. Orozco & P. Franco 789* (COL). **Cundinamarca:** Mpio. Pasca, vereda Los Colorados, Finca La Explanada, *L. Carvajal 1316* (COL). **Nariño:** Mpio. Pasto, parte alta bosque de Daza, Km. 12 [ruta] Pasto-Buesaco, *B. R. Ramírez P. & J. A. Cuayal M. 4031* (COL, MO). **Quindío:** Cordillera Central, Mpio. Salento, vereda Cocora, *W. G. Vargas 3151* (MO); Mpio. Salento, La Guayana, *W. G. Vargas 4452* (MO); Mpio. Genova, camino finca La Rusia, *M. C. Vélez, C. A. Agudelo & D. Macias 2314* (COL). **Risaralda:** Cordillera Central, vertiente occidental, Mpio. Pereira, hoya río Otún, camino de herradura El Cedral y El Bosque, *J. M. Idrobo, A. M. Cleef, O. Rangel & S. Salamanea 10231* (COL); Mpio. Pereira, vereda La Pastora, Parque Nac. Ucumarí, ca. 22 km ESE Pereira, *M. P. Galeano 64* (COL 3 sheets); *F. González & Curso Intr. Sist. Veg. 1560* (COL); *J. L. Luteyn & O. Rangel 13145* (COL, MO); *C. Murcia 268* (MO), *471* (MO); *O. Rangel, A. Gentry & Curso de Posgrado en Sistemática 5359* (COL); *F. J. Roldán, O. M. Mosquera, J. Niño, Y. M. Correa & J. E. Giraldo 3182* (MO).

14. Palicourea parrana C. M. Taylor, sp. nov. TYPE: Colombia. Meta: Cordillera La Macarena, extremo nordeste, macizo Renjifo, cumbre y alrededores, 1300–1900 m, 6–20 Jan. 1951, *J. M. Idrobo & R. E. Schultes 1012* (holotype, COL-68671!; isotypes, GH!, MO-5203900!, US-2029695!). Figure 3C, D.

Diagnosis. *Palicourea parrana* C. M. Taylor is distinguished from *Pal. paniculata* (L. f.) P. L. R. Moraes & C. M. Taylor by its longer pyramidal inflorescences, and from *Pal. petiolaris* Kunth by its longer corollas.

Shrubs and small trees flowering at 2 m tall, to 4 m tall; stems quadrangular, glabrous. Leaves opposite; blades elliptic to lance-elliptic, 8–19 × 3.5–9 cm, at base acute to obtuse, at apex acute to acuminate with tips 5–10 mm, drying papery, on both surfaces sparsely strigillose to glabrous; secondary veins 8 to 15 pairs, weakly extending to margins or sometimes weakly looping to interconnect in distal part of blade, with 1(2) short intersecondary vein(s) between pairs of secondary veins, without domatia, adaxially costa prominulous, secondary veins thickened, and remaining venation variously plane, thickened, or thinly prominulous, abaxially costa and secondary veins prominent and remaining venation prominulous; petioles 1–3.2 cm, glabrous; stipules persistent, laminar, glabrous, with unlobed basal portion 1.5–3 mm, truncate, lobes 2, ligulate, 1–3 mm, obtuse to rounded, with margins shortly densely ciliolate, separated by a concave to acute sinus. Inflorescences terminal, laxly paniculiform and often pendulous, pedunculate or apparently sessile and tripartite, glabrous, yellow or perhaps pale green; peduncle 6–15 cm; branched portion pyramidal, 11–28 × 16–30 cm, branched to 3 or 4 orders, with 5 to 7 pairs of secondary axes; bracts ligulate to lanceolate or triangular, acute, glabrous, those subtending secondary axes 1.5–6 mm, those subtending or borne on pedicels 0.5–1 mm; pedicels 3–10 mm. Flowers pedicellate in racemiform cymes of 3 to 7, whether distylous or homostylous unknown; hypanthium ellipsoid, 1–1.2 mm, glabrous; calyx limb 0.8–1 mm, glabrous, 5-lobed for ca. 1/2 its length, lobes ovate to triangular, acute; corolla tubular-funnelform, yellow or white sometimes flushed with pink, externally glabrous, tube (11)15–16 mm, ca. (2)3 mm diam., at base swollen and sometimes weakly gibbous, generally straight there and along its length, internally glabrous except with densely pilosulous ring ca. 1.5 mm wide just above basal swelling, lobes 5, triangular, ca. 2 mm, abaxially thickened, with sinuses sometimes extruded as a short sac, at apex acute and thickened; anthers (1.5)2–3 mm, partially exserted (included); stigmas 0.3–1 mm, exserted. Infructescences similar to inflorescences; fruit ovoid, ca. 4 × 4 mm, laterally flattened, glabrous, mature color unknown; pyrenes 2, planoconvex, abaxially pustulose and with 4 or 5 well-developed rounded ridges, adaxially plane except with narrow longitudinal median furrow. [*Palicourea* subg. *Montanae* sect. *Psychotrioides* ser. 8]

Habitat, distribution, and phenology. This species is found in wet forest at 1300–2260 m in Colombia, in the Cordillera Oriental, Cordillera Central, and Cordillera La Macarena; it has been collected in flower in January, April, June, August, and December, and with immature fruits in April and May.

Notes. *Palicourea parrana* is characterized by its rather small stipules with truncate sheaths and short, rounded to obtuse, ligulate lobes; its large, lax, pyramidal inflorescences with well-developed peduncles; its medium-sized tubular-funnelform white to yellow or pink flowers; and its ellipsoid, laterally flattened fruit. It is known from scattered collections in a region that is not well explored botanically. The flower measurements in parentheses are based on the specimen *Aguilar-Cano 627*, which has corollas that appear mature but are smaller than those of all the other specimens. These flowers may represent a variation in this species, but they may have opened prematurely during the drying process as occasionally happens in *Palicourea* and thus be immature. All of the flowers seen have the anthers situated near the corolla throat and the stigmas exserted, similarly to the long-styled flowers of distylous *Palicourea* species; whether *Pal. parrana* is distylous cannot yet be determined. This handsome new species is named in honor of Dr. Carlos Parra, a broadly accomplished Colombian botanist and a specialist in Myrtaceae as well as the valiant curator of the COL herbarium at the Institute of Natural Sciences of the National University of Colombia.

Palicourea parrana has been confused with the more commonly encountered species *Pal. paniculata* (formerly called *Pal. lineariflora* Wernham); *Pal. paniculata* can be separated by its shorter, broadly pyramidal to rounded-corymbiform inflorescences, with their branched portions 2–7 × 6–12 cm, and its longer pendulous flowers with corolla tubes 13–18 mm long. *Palicourea parrana* is also similar to *Pal. petiolaris* of Venezuela; *Pal. petiolaris* can be recognized by its smaller corollas, with tubes 6.5–8 mm long and ca. 1 mm diam. near the middle.

Paratypes. COLOMBIA. **Cundinamarca:** Mpio. Albán, granjas infantiles de P. Luna "El Buen Ciudadano," *E. Forero-González 136* (COL); La María, *E. Forero 146* (COL); Pacho-Paime Hwy., *O. Haught 6064* (COL). **Santander:** Mpio. El Carmen, vereda La Bodega, Parque Nac. Natural Serranía de los Yariguíes, entre quebrada San Guillerma y Camino de Agua, *J. Aguilar-Cano 627* (COL); Mpio. Encino, Reserva Biológica Cachalú, camino cascada La Ducha, orillas quebrada Gallito de Roca, *M. Reina, R. López, S. Angel & A. Avila 138* (COL). **Tolima:** near La Colombia, E Andalucía, *E. L. Little, Jr. 7132* (COL).

15. Palicourea sanchezii (C. M. Taylor) C. M. Taylor, comb. nov. Basionym: *Psychotria sanchezii* C. M. Taylor, Novon 7(2): 198, fig. 4. 1997. TYPE: Colombia. Antioquia: Mpio. Frontino, correg. Nutibara, cuenca alta del Río Cuevas, 17 Mar. 1984, *D. Sánchez, C. Orrego, S. Sylva, G. Martínez, D. Restrepo & R. Bernal 98* (holotype, MEDEL!; isotype, MO-04990809!).

Habitat and distribution. *Palicourea sanchezii* is found in wet forest at 1000–2080 m in northwestern Colombia.

Notes. *Palicourea sanchezii* was described in *Psychotria* based on the taxonomy of that time, which separated species with yellow to white corollas that are not swollen at the base and placed them in that genus; only species with brightly colored corollas that are swollen at the base were included at that time in *Palicourea* (Taylor, 1997). However, it is now clear that *Palicourea* includes far more species with wide variation in form and color of the corollas, and that *Psy. sanchezii* is most closely related to several species currently classified in *Palicourea*. Accordingly, this species is transferred here to *Palicourea* and classified in *Palicourea* subg. *Montanae* sect. *Montanae* ser. 4 subser. f.

Palicourea sanchezii is similar in particular to *Pal. standleyana*; *Pal. sanchezii* can be recognized by its densely hirsute to pilose or pilosulous stipule sheaths, inflorescences with three subcapitate groups of about five to seven flowers, and well-developed calyx limbs (11–19 mm long) that are deeply lobed, while *Pal. standleyana* has sparsely pilose or hirsute to glabrescent stipule sheaths, lax inflorescences branched to three to four orders with dichasial cymes of five to 15 flowers, and shorter calyx limbs (3–4.5 mm long) that are lobed for less than half their length. Both of these species are similar to *Pal. betancuriana*, which is described earlier in this article; for its distinctions see the discussion of *Pal. betancuriana*.

16. Palicourea sancti-ciprianii C. M. Taylor, sp. nov. TYPE: Colombia. Valle del Cauca: Mpio. Calima, El Chanco, alrededores del campamento CVC, márgen izquierda del río Calima, 31 Mar. 1985, *R. Ruíz, L. Camargo & O. Daza 31* (holotype, COL-286993!). Figure 2C, D.

Diagnosis. *Palicourea sancti-ciprianii* C. M. Taylor is distinguished from *Pal. vulcanalis* Standl. ex C. M. Taylor and *Pal. deviae* C. M. Taylor by its stipules with shorter sheaths and its smaller inflorescences and leaves, and from *Psychotria trianae* Standl. by its petiolate elliptic leaves and shorter peduncles.

Shrubs and small trees flowering at 1 m tall, to 3 m tall; stems quadrangular to somewhat flattened, densely hirtellous or scabrous-pilosulous to occasionally glabrescent. Leaves opposite; blades elliptic to lanceolate, 6–18 × 1.8–4.8 cm, at base acute to cuneate, at apex acuminate with slender tips 10–25 mm, drying papyraceous, adaxially glabrous or pilosulous along costa, abaxially densely pilosulous on costa, densely puberulous to pilosulous on remaining venation, and puberulous to glabrescent on lamina; secondary veins 13 to 21 pairs, looping to interconnect near margins, with 1(2) well-developed intersecondary vein(s) present between pairs of secondary veins, without domatia, adaxially costa prominent and remaining venation plane to thickened, abaxially costa and secondary veins prominent and remaining venation prominulous; petioles 0.5–2.8 cm, densely pilosulous to puberulous; stipules persistent and becoming indurated or scarious with lobes deciduous by fragmentation, united around stem or with intrapetiolar portion reduced, densely pilosulous-scabrous or hirtellous to glabrescent, sheath 1–3 mm, lobes 2 on each interpetiolar side, narrowly triangular to narrowly ligulate, 7–17 mm, acute, with margins ciliolate, separated by a truncate to broadly concave sinus. Inflorescences terminal, often becoming displaced to pseudoaxillary, paniculiform, pedunculate, densely pilosulous to hirtellous, apparently green or yellow; peduncle 2–4.8 cm; branched portion pyramidal, 2.5–4 × 2–4 cm, branched to 3 or 4 orders, with 4 to 6 pairs of secondary veins; bracts narrowly triangular to narrowly ligulate, acute, glabrous, entire to ciliolate, those subtending secondary axes 4–7.5 mm, those subtending flowers 1.8–4 mm; pedicels 0.5–2 mm. Flowers pedicellate in dichasial cymes of 5 to 7, whether distylous or homostylous unknown; hypanthium ellipsoid to obconic, 0.5–0.8 mm, glabrous; calyx limb 0.6–0.8 mm, glabrous, 5-lobed for 1/2–3/4 its length, lobes triangular, acute; corolla white, in bud with lobes thickened abaxially; anthers and stigmas not seen. Infructescences and fruits not seen. [*Palicourea* subg. *Montanae* sect. *Montanae* ser. 3 subser. c]

Habitat, distribution, and phenology. *Palicourea sancti-ciprianii* is found in wet forest at 5–1400 m in Pacific western Colombia and northwestern Ecuador; it has been collected in flower bud in February through April.

Notes. *Palicourea sancti-ciprianii* is characterized by its petiolate elliptic leaves with the higher-order venation rather closely reticulated, its stipules that become indurated or scarious then deciduous by fragmentation, its pyramidal paniculiform inflorescences with regularly well-developed bracts, and its rather short calyx limbs. Mature corollas and fruits of this new species have not been seen, but the combination of its vegetative and inflorescence characters is distinctive and matches no other known species. *Palicourea sancti-ciprianii* has been found at scattered localities in the very wet forests of the Pacific slopes of Colombia and northwestern Ecuador; one of these sites is San Cipriano, and the specific epithet refers to this locality.

Palicourea sancti-ciprianii is similar to *Pal. vulcanalis*, which is known from scattered localities from northwestern Colombia through northern Peru; *Pal. vulcanalis* can be separated by its leaves with the higher-order venation regularly prominulous on the upper surface, its longer stipule sheaths 7–9 mm long, its larger inflorescences with the branched portions 5–15 × 6–15 cm, and its habitat at higher elevations (1700–2650 m). *Palicourea sancti-ciprianii* has been confused in sched. with *Psychotria trianae*, which is also found in western Colombia; *Psy. trianae* can be separated by its generally similar stipules that have reflexed lobes, its subsessile ovate leaves, its usually longer peduncles 4–15.5 cm, and its flowers that are sessile on spiciform axes. *Palicourea sancti-ciprianii* is also similar to *Pal. angustifolia* Kunth, which is found widely in montane Colombia at 1200–2750 m; *Pal. angustifolia* can be separated by its persistent, narrowly triangular to linear stipule lobes 4–8 mm and its bright purple inflorescences and flowers.

Paratypes. COLOMBIA. **Valle del Cauca:** Mpio. Buenaventura, río Cajambre, Barco, *J. Cuatrecasas 17022* (COL); correg. Córdoba, vereda San Cipriano, Reserva Natural Escalerete, quebrada Culebra sector S, *W. Devia, D. Cárdenas & A. Cruz 4115* (COL); parcela permanente, *C. M. Taylor, W. Devia, R. E. Gereau, J. Adarve & R. Olave 12124* (MO, TULV). ECUADOR. **Carchi:** above Tobar-Donoso to Río Guape, *W. S. Hoover 1144* (MO).

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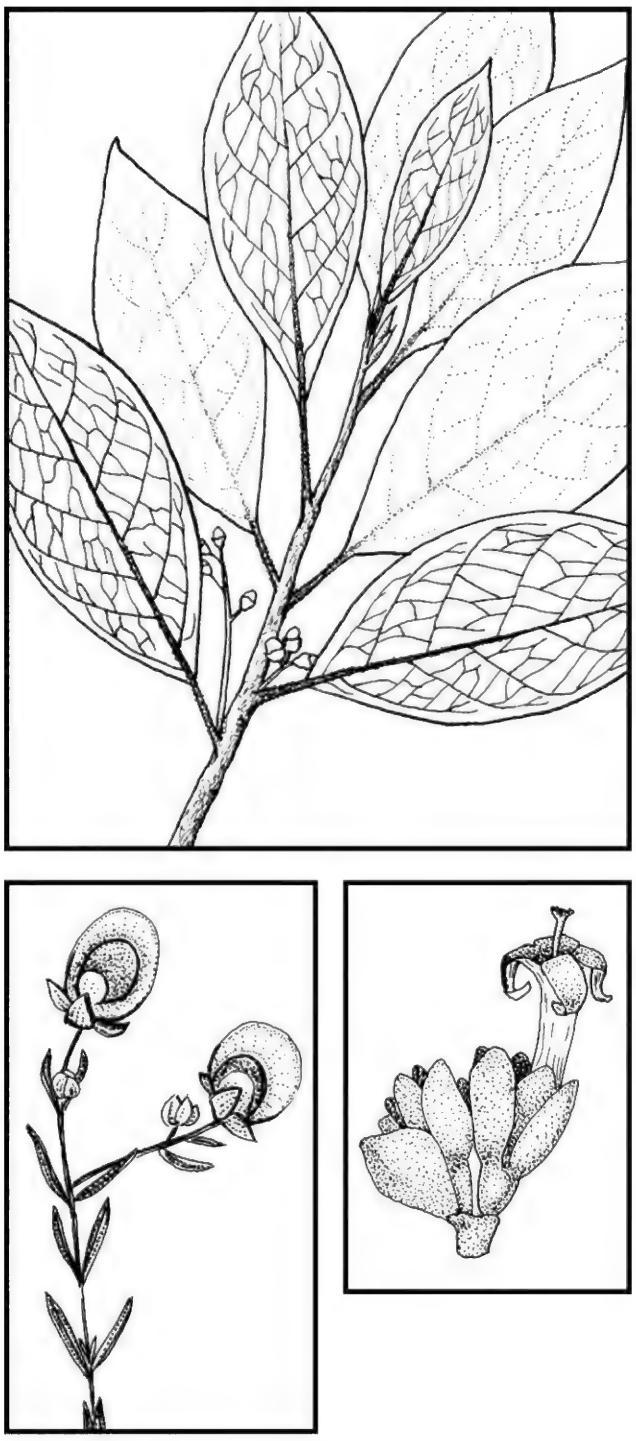

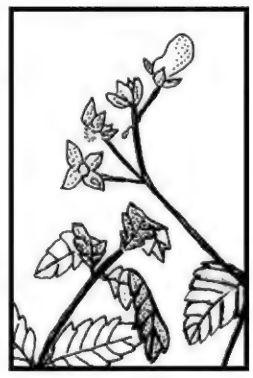

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Dactylocardamum polyspermum (Brassicaceae), a Second Remarkable New Species from Peru

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Abstract. *Dactylocardamum polyspermum* Al-Shehbaz, A. Cano & Trinidad, the second species of a previously monospecific Peruvian genus, is described and illustrated, its similarities to and distinguishing characters from the generic type, *D. imbricatifolium* Al-Shehbaz, are discussed, and the generic limits of *Dactylocardamum* Al-Shehbaz are expanded to accommodate the new species. The novelty is known from a single locality in Ancash Department, and its IUCN conservation status is determined as Data Deficient.

Key words: Ancash, Brassicaceae, Cruciferae, *Dactylocardamum*, IUCN Red List, Peru.

During fieldwork by one of us (A. C.), a peculiar, densely cushion-forming plant was discovered. It did not fit in any of the known Peruvian members of Brassicaceae (Cruciferae), though some resemblance to the narrowly endemic, Peruvian, monospecific *Dactylocardamum* Al-Shehbaz was noticed. Subsequently, a closer comparison with the generic type confirmed its novelty, and it is described below.

Although *Dactylocardamum* was not assigned to any tribe for 25 years after its discovery (Al-Shehbaz, 1989; Al-Shehbaz et al., 2006), it was placed by Al-Shehbaz (2012) in the tribe Eudemeae solely on morphological grounds. However, recent molecular phylogenetic studies (Salariato et al., 2014, 2016) have strongly confirmed that placement.

Dactylocardamum polyspermum Al-Shehbaz, A. Cano & Trinidad, sp. nov. TYPE: Peru. Dpto. Ancash: Prov. Asunción, Chacas, abajo de Punta Olímpica, ladera rocosa cerca de laguna, 224190/8989152 (9°8′9.70″S 77°30′34.17″W), 4450–4550 m, 5 Sep. 2012, *A. Cano 20898a* (holotype, USM-294474!; isotype, MO-6701854!). Figures 1, 2.

Diagnosis. This species is distinguished from *Dactylocardamum imbricatifolium* Al-Shehbaz by having 14- to 16-ovuled (vs. 2-ovuled) ovaries, oblong and pubescent (vs. ovate and glabrous) fruit with branched trichomes, longer fruiting pedicels (5–12 mm vs. ca. 0.5 mm) and styles (5–7 mm vs. 2.5–3 mm), septum reduced to a rim (vs. lacking), and biseriate (vs. aseriate) seeds.

Herbs, densely pulvinate perennials. Stems extensively branched, the branches rather slender, covered with petiolar remains of previous seasons. Leaves cauline, imbricate, not fleshy, blade obovate to spatulate or narrowly oblanceolate, 2–4 × 1–3 mm, ciliate and densely subsetose adaxially with simple trichomes 0.5–1.2 mm, glabrous abaxially, apex acute, margin entire, base attenuate to petiole 2–3 mm that

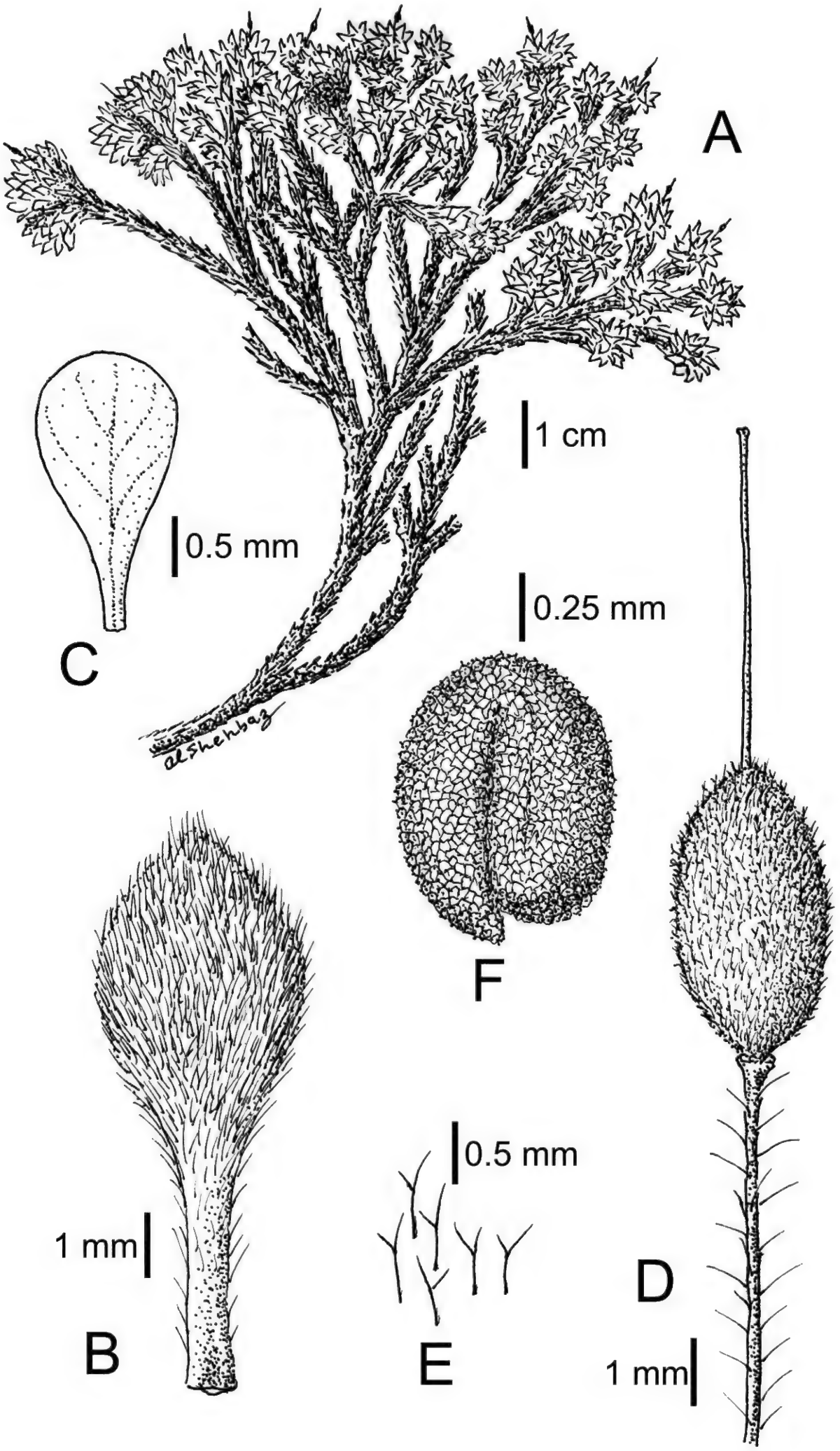

Figure 1. *Dactylocardamum polyspermum* Al-Shehbaz, A. Cano & Trinidad. —A. Portion of plant. —B. Leaf. —C. Petal. —D. Fruit and fruiting pedicel. —E. Fruit trichomes. —F. Seed. Drawn by Al-Shehbaz from the isotype *A. Cano 20898a* (MO).

persists and becomes papery in subsequent seasons. Flowers on solitary pedicels from axils of uppermost leaves, 1 or 2(to 4) at branch apex; fruiting pedicels slender, 5–12 mm, pubescent all around with spreading to ascending simple trichomes to 1 mm, becoming axillary as stems grow in subsequent seasons. Sepals ovate, 3.5–5 mm, erect, subsaccate at base, sparsely pubescent; petals white, broadly obovate, 8–10 × 4–5 mm, rounded at apex, abruptly narrowed to clawlike base, 1.5–2 mm; filaments 4–5 mm; anthers oblong, 1–

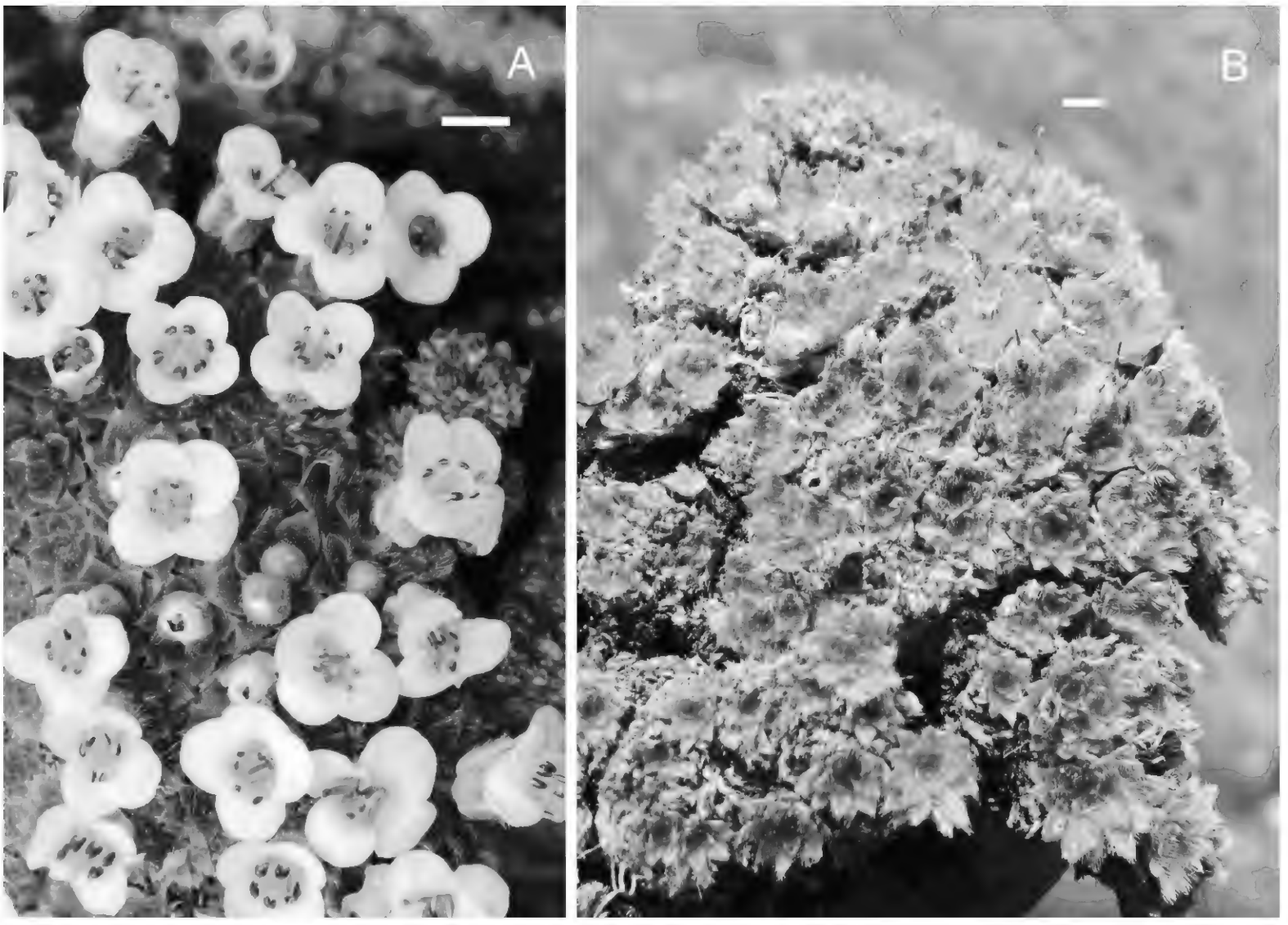

Figure 2. *Dactylocardamum polyspermum* Al-Shehbaz, A. Cano & Trinidad. —A. Flowering plant. —B. Fruiting plant. Scale bars: A = 10 mm; B = 5 mm. Photo by Huber Trinidad.

1.3 mm; nectar glands confluent, subtending bases of all filaments; ovules 14 to 16 per ovary. Fruit oblong, 3.5–5 × 2–2.5 mm, densely pubescent with stalked, often unequal-rayed, Y-shaped, forked trichomes to 0.5 mm; style filiform, 5–7 mm, glabrous; stigma capitate, slightly 2-lobed. Seeds biseriate, ovoid, 0.7–0.8 × 0.5–0.6 mm, papillate-reticulate.

Phenology. Flowering and fruiting times for *Dactylocardamum polyspermum* are from March to April and August to September.

Habitat. *Dactylocardamum polyspermum* is found on rocky slope near a lagoon in mixed grassland.

IUCN Red List category. *Dactylocardamum polyspermum* is known only from the type collections and is therefore given the assessment of Data Deficient (DD) according to IUCN (2001) criteria.

Discussion. *Dactylocardamum polyspermum* resembles *D. imbricatifolium* in being a strongly pulvinate perennial with densely imbricate cauline leaves pubescent adaxially and glabrous abaxially and in having flowers on lateral, solitary pedicels originating from axils of uppermost leaves. It differs by having 14 to 16 ovules on parietal placentae, oblong fruit densely pubescent with forked, Y-shaped trichomes, fruiting pedicels 5–12 mm, styles 5–7 mm, broadly obovate petals 8–10 × 4–5 mm, septum reduced to a narrow rim, confluent nectar gland subtending bases of all filaments, and biseriate seeds. By contrast, *D. imbricatifolium*, which is known only from Cordillera Blanca (Dpto. Ancash and Prov. Yungay), has two subapical ovules; ovate, glabrous fruit; fruiting pedicels ca. 0.5 mm; styles 2.5–3 mm; oblanceolate-linear petals 4–4.5 × ca. 1 mm; septum completely lacking; four nectar glands, one on each side of lateral stamens; and aseriate seeds.

The discovery of *Dactylocardamum polyspermum* and its substantial differences from *D. imbricatifolium* necessitated the expansion of the generic limits as below.

Dactylocardamum Al-Shehbaz, J. Arnold Arbor. 70: 519. 1989.

Herbs, perennial, forming dense cushions; caudex woody with extensive, finger-like branches or non-woody, slender, and with numerous non-finger-like branches. Trichomes simple or forked, Y-shaped. Multicellular glands absent. Stems many branched, erect to ascending, glabrous. Basal leaves absent; cauline leaves sessile, not auriculate, entire, densely

imbricate, persistent. Flowers solitary from axils of uppermost leaves; fruiting pedicels persistent, becoming axillary as stems grow in subsequent seasons. Sepals oblong or ovate, free, deciduous, erect, equal, membranous, base of inner pair subsaccate or not; petals longer than sepals, erect, flaring distally; blade broadly obovate or oblanceolate-linear, obtuse or rounded at apex; claw undifferentiated; stamens 6, slightly tetradynamous; filaments wingless, unappendaged, glabrous, free, not dilated at base, filiform; anthers oblong, not apiculate at apex; nectar glands 4, lateral and 1 on each side of lateral stamens, or confluent and subtending bases of all filaments; ovaries with ovules 2 on subapical placentae or 14 to 16 on parietal placentae. Fruit tardily or readily dehiscent, capsular silicles, ovoid to oblong, terete, not inflated, sessile; valves thin papery, veinless, glabrous or pubescent with Y-shaped forked trichomes, not keeled, smooth, wingless, unappendaged; gynophore obsolete; replum rounded, visible; septum absent or reduced to a rim; style filiform, persistent, glabrous, 2.5–7 mm; stigma capitate, entire or slightly 2-lobed, unappendaged. Seeds aseriate or biseriate, wingless, ovoid, plump; seed coat reticulate or reticulate-papillate; cotyledons incumbent.

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Typification of *Allium peroninianum* (Amaryllidaceae) Described by Aznavour from Turkey

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Abstract. The typification of the name *Allium peroninianum* Azn. is discussed. A specimen from the Genève herbarium is designated as the lectotype.

Key words: *Allium*, Amaryllidaceae.

Allium L. is a member of the family Amaryllidaceae, subfamily Allioideae, tribe Allieae (Fay & Chase, 1996; APG III, 2009; Chase et al., 2009; Li et al., 2010). The history of infrageneric classification in *Allium* starts with Linnaeus (1753) who accepted 30 species, grouped in three "alliances." Later authors recognized an increasing number of species and infrageneric groups. This genus is now one of the largest monocot genera with close to 850 species currently recognized (Wheeler et al., 2013; Peruzzi et al., 2016).

Allium peroninianum Azn. was first collected by Georges Vincent Aznavour from Yakacık Mountain (İstanbul); he subsequently (1897) published it as a new species. Aznavour (1861–1920) was an amateur botanist who lived in İstanbul. From 1885 on, he collected plant specimens from İstanbul and its vicinity. Peter H. Davis (1918–1992) and his collaborators benefited from Aznavour's work while preparing the *Flora of Turkey and the East Aegean Islands* (1965–1988) in Edinburgh. In this Flora, 1601 specimens collected by Aznavour are cited, of which 32 are cited as types, syntypes, or lectotypes (Baytop, 2012).

In the protologue of *Allium peroninianum*, Aznavour (1897: 175) quotes localities for this taxon as: "endroits rocheux de Yacadjik-Dagh et de Calche Dagh, non loin de Maltepe (A.) [= Asiatic part of Turkey], altit. = 250-400 m." Kollmann (1984) revised the genus *Allium* for the *Flora of Turkey and the East Aegean Islands* and identified two syntypes in the Genève herbarium (G00165022 and G00165023) for *A. peroninianum*. However, he did not select one as the lectotype; lectotypification is therefore performed here.

Both of the specimens at G are numbered "Aznavour 2202 bis." Specimen G00165023 bears a label reading "Caïche dagh, 28 août, 1893"; G00165022 bears a label reading "Yacadjik dagh, 20 août, 1893." Since G00165022 and G00165023 were collected from different localities on different dates, these specimens are not duplicates. *Aznavour 2202 bis* (G00165023) was selected as the lectotype because of its better condition.

Because many of Aznavour's personal collections are at E, an inquiry was made as to whether suitable type material could be found at E; this did not result in the location of other sheets of original material. On the other hand, material of *Allium peroninianum* collected by Aznavour can be found at BM and K (respectively BM001066510 and K000098763, images available through JSTOR). These are both labeled "*Plantes de Constantinople*, endroits rocheux de Yacadjik-Dagh" and dated 1900. Since they were collected three years after the publication of *A. peroninianum*, they are not original material.

Allium peroninianum Azn., Bull. Soc. Bot. France 44: 175. 1897. TYPE: Turkey. İstanbul: Caïche Dagh [Kayış Da], 28 Aug. 1893, *G. Aznavour 2202 bis* (lectotype, designated here, G [barcode] G00165023, image!). Figure 1.

Acknowledgments. The author thanks the curators of the herbaria cited in the text for supplying specimens. I would like to thank Dr. Wendy L. Applequist, Lisa Pepper, and two anonymous reviewers for making many useful suggestions that greatly improved the manuscript.

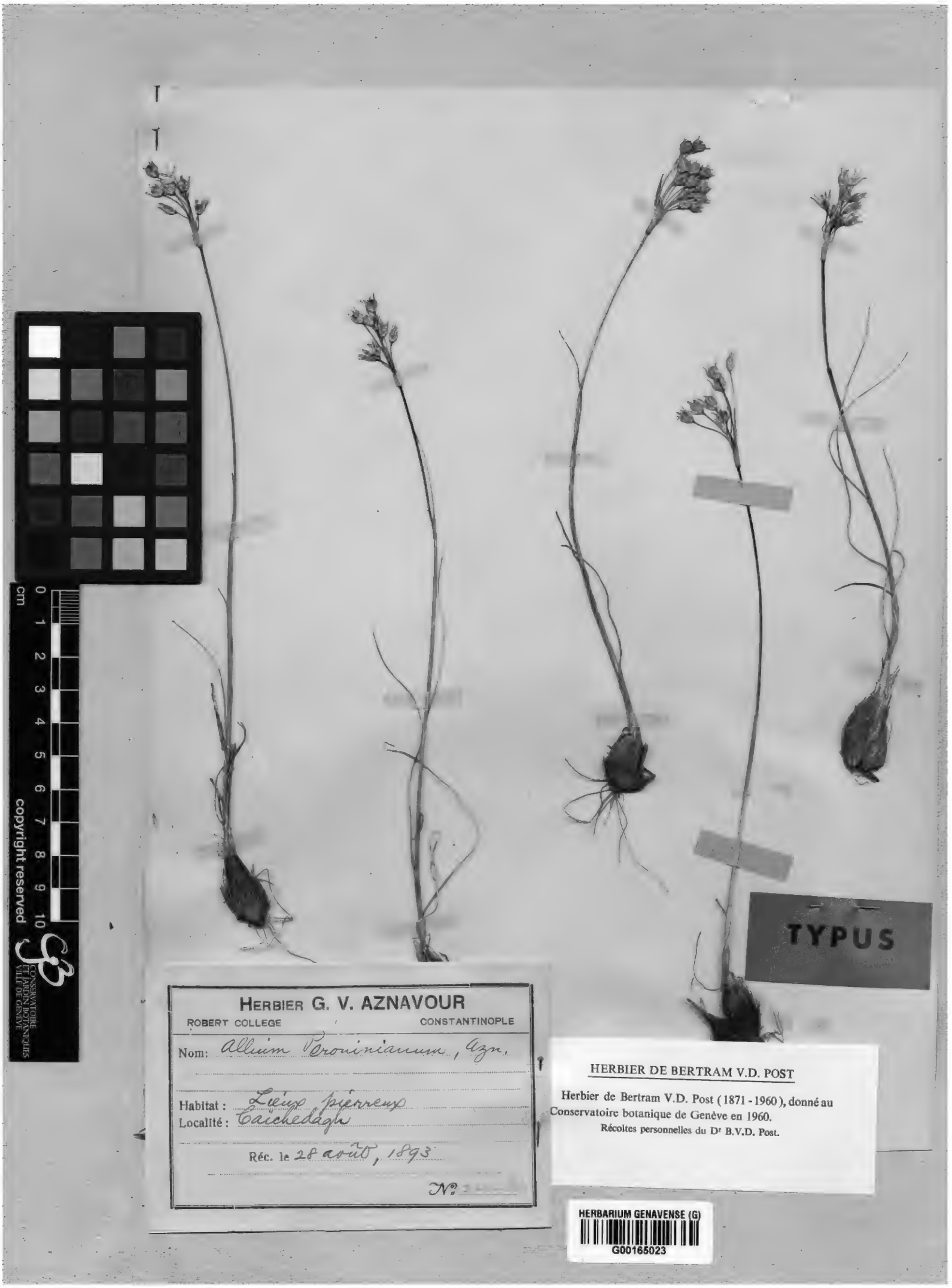
HERBIER G. V. AZNAVOUR
ROBERT COLLEGE CONSTANTINOPLE
Nom: Allium Peroninianum, Azn.
Habitat : Lieux pierreux
Localité : Caichedagh
Réc. le 28 août, 1893
N°
TYPUS
HERBIER DE BERTRAM V.D. POST
Herbier de Bertram V.D. Post (1871 - 1960), donné au Conservatoire botanique de Genève en 1960.
Récoltes personnelles du Dr B.V.D. Post.
HERBARIUM GENAVENSE (G)
G00165023
copyright reserved
CONSERVATOIRE ET JARDIN BOTANIQUES VILLE DE GENÈVE

Figure 1. Lectotype of the name *Allium peroninianum* Azn. (*Aznavour 2202 bis.*, G, with barcode G00165023). Photograph reproduced with permission of Conservatoire et Jardin botaniques de la Ville de Genève.

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Nine New Species of the Species-rich Genus *Astragalus* (Leguminosae)

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Abstract. As a result of our taxonomic studies of *Astragalus* L. sect. *Hymenostegis* Bunge, we recognize nine new species of this genus from Zanjan Province in northwestern Iran, namely: *A. atrokurdicus* Maassoumi, F. Ghahrem., Bagheri & Podlech, *A. austrotaromensis* Maassoumi, F. Ghahrem., Bagheri & Podlech, *A. dejectus* Maassoumi, F. Ghahrem. & Bagheri, *A. mostafa-assadii* Bagheri, Maassoumi, F. Ghahrem. & Podlech, *A. paralurgiformis* F. Ghahrem., Maassoumi & Bagheri, *A. pluriflorus* F. Ghahrem., Maassoumi, Bagheri & Podlech, *A. pseudoparalurges* F. Ghahrem., Maassoumi, Bagheri & Podlech, *A. sohrevardianus* Bagheri, Maassoumi & F. Ghahrem., and *A. sublaguriformis* Bagheri, Maassoumi & F. Ghahrem., which are described and illustrated here. The new species are also compared with the taxa that are morphologically most similar and presumed to be closely related.

Key words: *Astragalus* sect. *Hymenostegis*, Fabaceae, Iran, Zanjan Province.

Astragalus L. (Leguminosae), with 2950 species, is the largest genus of flowering plants in the world (Podlech & Zarre, 2013). The genus is also the largest genus of the flora of Iran, with 826 species representing 10.5% of the plant species of the country (Ghahremaninejad, 2015). *Astragalus* sect. *Hymenostegis* Bunge is one of the larger sections that characteristically have spines. Iran, especially the northwest of the country, is the main center of diversity of this section (Bagheri et al., 2011, 2015). This section has been revised four times during the past two decades (Maassoumi, 1995; Zarre & Podlech, 1996; Podlech & Maassoumi, 2001; Podlech & Zarre, 2013). Still, Maassoumi (2007: 78), in describing two new species of *Astragalus* sect. *Hymenostegis*, wrote: "it seems that with new collections, the number of taxa will be increased." Recently, several new species were described (Bagheri et al., 2011, 2013, 2014, 2016; Ghahremaninejad et al., 2016), resulting in 62 species recognized for this section worldwide. However, in the course of a revision of the section involving field studies, we realized that additional diversity is present within the section. Here, we describe nine new species belonging to *Astragalus* sect. *Hymenostegis*.

During botanical expeditions to Zanjan Province in northwestern Iran between 2008 and 2011, numerous *Astragalus* sect. *Hymenostegis* taxa were collected by the first author. Using the relevant literature (Podlech & Maassoumi, 2001; Podlech & Zarre, 2013) and examining the relevant herbarium specimens (including type materials) in the herbaria B, FAR, HUI, M, MSB, T, TARI, and W, some specimens could not be determined. However, the observation of clear morphological differences between them and the most similar known taxa allows us to recognize them as species new to science. Holotypes of the new species were deposited in T and TARI, and isotypes were deposited in FAR, HUI, MSB, T, and TARI herbaria. All nine of the new species described below occur in Zanjan Province, northwestern Iran, and are endemic to this province. They are Irano-Turanian elements and to now are mostly only known from their type localities in the mid-montane zone (1700–2900 m elevation). *Astragalus* sect. *Hymenostegis* now comprises 71 species, of which 33 (46.5%) occur in Zanjan Province and 19 (26.8%) are endemic to this province. Thus, Zanjan Province might be considered the main center of diversity for this section.

1. Astragalus atrokurdicus Maassoumi, F. Ghahrem., Bagheri & Podlech, sp. nov. TYPE: Iran. Zanjan: 84 km from Zanjan to Bijar, 1550 m, 26 May 2009 (fl.), *Bagheri 6911* (holotype, T!; isotypes, MSB!, TARI!). Figure 1.

Haec species ab *Astragalo sosnowskyi* Grossh. pedunculo trichomatibus appressis vel subappressis (nec patentibus) dense obtecto, bracteis membranaceis margine hyalino (nec chartaceis) glabris (nec in linea media et apicem versus pilosis), calyce flavido usque violaceo (nec pallide flavido vel luteo) dentibus violaceis (nec luteis), petalis violaceis (nec pallide flavidis) et vexillo ad apicem acuto (nec rotundato usque emarginato) differt.

Plants subshrubs, caespitose, ca. 15 cm tall. Stems in the older parts ligneous, to 1 cm, branching from the base and covered with brownish bark and remnants of old petioles and stipules; younger stems in the current year ca. 1.5 cm. Stipules hyaline-membranous, 14–17 mm, triangular, acuminate, adnate to the petiole for 8–10 mm, very shortly connate, glabrous or ciliate at the margins. Leaves including petiole 1.5–4 cm; petiole 0.5–1.5 cm, both petiole and rachis densely covered with ascending to spreading hairs 0.4–0.8 mm. Leaflets opposite, in 6 to 7 pairs, narrowly elliptic to elliptic, 5–12 × 1–1.5 mm, acuminate, pungent, with a cusp ca. 0.5 mm, on both sides densely covered with ascending to spreading hairs 0.4–0.8 mm, terminal leaflets modified to a spine. Inflorescence a terminal raceme; peduncle 9–10 cm, densely covered with appressed to subappressed hairs to 1 mm. Racemes ovoid, ca. 4 × 2.5 cm, densely many-flowered. Bracts mostly persistent, triangular, membranous, hyaline at the margins, acuminate, 12–13 × 3–5 mm, glabrous. Calyx inflated, 14–16 mm, yellowish creamy to purplish, densely covered with ascending to spreading hairs to 3.5 mm; teeth subulate, purplish, ca. 4 mm. Petals purplish to violet or rarely greenish, glabrous. Standard 16–18 mm; blade 6–7 mm wide, distinctly acute at apex, hastate-auriculate at base, below the middle slightly constricted, gradually narrowed into the rather wide claw. Wings 16–17 mm; blade narrowly oblong, subacute, 6–7 × 2–3 mm; auricle ca. 0.5 mm; claw ca. 10 mm. Keel petals ca. 15 mm; blade obliquely obovate, subacute, 5 × 3 mm; auricle indistinct; claw ca. 9 mm. Keel and claws of wings adnate to staminal tube for 0.5 mm. Stamens ca. 14 mm, diadelphous, 9 + 1, connate stamens free in upper 2–3 mm. Ovary 5–6 mm, sessile, hairy. Legumes unknown.

Etymology. The specific epithet *atrokurdicus* refers to the type locality of the new species from the boundary of Azerbaijan (Zanjan) and Kordestan Provinces.

Discussion. *Astragalus sosnowskyi* Grossh. is the only species that shows a close similarity to *A. atrokurdicus*. However, *A. atrokurdicus* differs in several characters, including: peduncle indument appressed to subappressed (vs. spreading to tangled in *A. sosnowskyi*); bracts membranous to hyaline, glabrous (vs. chartaceous to thinly glumaceous, sometimes hairy along the midline); calyx and teeth yellow to violet (vs. pale yellowish or creamy); petals dark violet to brownish in dry stage (vs. pale yellowish); and standard apex acute (vs. rounded to emarginate). *Astragalus sosnowskyi* occurs in northwestern Iran, eastern Turkey, and Georgia (Podlech & Zarre, 2013), while *A. atrokurdicus* is only known from the type locality and is endemic to Zanjan Province in northwestern Iran.

2. Astragalus austrotaromensis Maassoumi, F. Ghahrem., Bagheri & Podlech, sp. nov. TYPE: Iran. Zanjan: 50 km from Zanjan to Tarom, 2250 m, 27 May 2009 (fl.), *Bagheri 6942* (holotype, T!; isotypes, FAR!, HUI!, MSB!, TARI!). Figure 2.

Haec species ab *Astragalo kapherriano* Fisch., *A. karl-heinzii* Maassoumi et *A. rubrostriato* Bunge stipulis longioribus et bracteis hyalinis usque membranaceis differt; etiam ab *A. kapherriano* et *A. karl-heinzii* foliolis longioribus; ab *A. kapherriano* pedunculi trichomatibus longioribus, inflorescentiis longioribus cylindricis usque conicis, calycis dentibus et vexillo longioribus; ab *A. karl-heinzii* pedunculi longioris trichomatibus patentibus vel subappressis et calycis trichomatibus longioribus; ab *A. rubrostriato* rhachidis foliaris trichomatibus adscendentibus longioribus differt.

Plants subshrubs, caespitose, 20–25 cm tall. Stems in the older parts ligneous, to 3 cm, branching from the base and covered with brownish bark and remnants of old petioles and stipules; younger stems in the current year ca. 2 cm. Stipules hyaline-membranous, 20–25 mm, triangular-acuminate, adnate to the petiole for 10–15 mm, 3–4 mm connate, ciliate at the margins, sometimes glabrous. Leaves including petiole 5–8 cm; petiole 2–2.5 cm, both petiole and rachis densely covered with ascending hairs 1 mm. Leaflets opposite, in 4 to 6 pairs, narrowly elliptic to lanceolate, 18–32 × 1–2.5 mm, acuminate at apex, pungent, with a yellowish cusp 1–1.5 mm, on both sides densely covered with ascending to spreading hairs 0.5–1 mm, terminal leaflets modified to a spine. Inflorescence a terminal raceme; peduncle 5–6.5 cm, densely covered with tangled, ascending hairs to 2.5 mm mixed with very short, spreading hairs to 0.5 mm. Racemes cylindrical, conoid, 12–15 × 1.5–3.5 cm, loosely to densely many-flowered, axis densely covered with ascending hairs to 2 mm. Bracts mostly persistent, broadly ovate

Figure 1. *Astragalus atrokurdicus* Maassoumi, F. Ghahrem., Bagheri & Podlech. Photographed from the holotype, *Bagheri 6911* (T).

Figure 2. *Astragalus austrotaromensis* Maassoumi, F. Ghahrem., Bagheri & Podlech. Photographed from the holotype, *Bagheri 6942* (T).

to lanceolate, membranous, hyaline at the margins, acuminate at apex, 15–23 × 3–5 mm, glabrous, upper bracts at the apex purplish, sparsely ciliate at the margins. Calyx inflated, 16–20 mm, purplish to violet, rarely at the base whitish to creamy, densely covered with ascending to spreading, white hairs to 4 mm; teeth subulate, violet, 7–8.5 mm. Petals purple to violet or pale whitish, glabrous. Standard 21–24 mm; blade 6–8 mm wide, rounded or slightly emarginate at apex, hastate-auriculate at base, below the middle slightly constricted, gradually narrowed into the rather wide claw. Wings ca. 21 mm; blade narrowly oblong, obtuse at apex, 9–10 × 2–3 mm; auricle ca. 0.5 mm; claw ca. 13 mm. Keel petal ca. 18 mm; blade obliquely obovate, subacute at apex, 4–7 × 2–3 mm; auricle indistinct; claw ca. 12 mm. Keel and claws of wings adnate to staminal tube for 0.5–1 mm. Stamens 15–18 mm, diadelphous, 9 + 1, connate stamens free in upper 3–4 mm. Ovary 5–6 mm, sessile, hairy. Legumes unknown.

Etymology. The specific epithet *austrotaromensis* refers to the type locality of the new species from Tarom in Zanjan Province.

Discussion. *Astragalus austrotaromensis* shares some characters with several closely related taxa but is easily distinguishable from them by morphology. It differs from *A. kapherrianus* Fisch. by having longer stipules and leaflets; longer hairs on peduncles; longer and cylindrical to conical (vs. short and ovoid) inflorescences; hyaline to membranous (vs. chartaceous) bracts; and longer calyx, teeth, and standard. It differs from *A. karl-heinzii* Maassoumi by having longer stipules and leaflets; spreading to ascending (vs. subappressed) hairs on peduncles; longer peduncles; hyaline to membranous (vs. chartaceous) bracts; and longer hairs on the calyx. The taxon differs from *A. rubrostriatus* Bunge in having longer stipules; ascending and longer (vs. appressed and shorter) hairs on the leaf rachis; and hyaline to membranous (vs. chartaceous) bracts. Both *A. karl-heinzii* and *A. rubrostriatus* are endemic to Iran and occur in the northwest of the country, while *A. kapherrianus* is found in northwestern Iran and Azerbaijan. The new species *A. austrotaromensis* is endemic to the Tarom Region at the boundary of Zanjan and Gilan Provinces.

3. Astragalus dejectus Maassoumi, F. Ghahrem. & Bagheri, sp. nov. TYPE: Iran. Zanjan: Gheydar, Gheydar Mt., 2475 m, 10 July 2009 (fl.), *Bagheri 9079* (holotype, T!; isotypes, FAR!, HUI!, MSB!, TARI!). Figure 3.

Haec species ab *Astragalo qorvehensi* Podlech stipulis 17–20 (nec 8–12) mm longis ad petiolum per 9–11 (nec ca. 5) mm adnatis, pedunculis 0.5–2.5 cm longis foliis brevioribus (nec 12–15 cm foliis longioribus), bracteis 11–15 (nec 8–9) mm longis et vexillo apice acuminato (nec rotundato) differt.

Plants subshrubs, caespitose, to 10 cm tall. Stems in the older parts ligneous, to 3 cm, branching from the base and covered with brownish bark and remnants of old petioles and stipules; younger stems in the current year ca. 2 cm. Stipules chartaceous, narrowly hyaline at the margins, 17–20 mm, triangular-acuminate, adnate to the petiole for 9–11 mm, 3 mm connate, ciliate at the margins. Leaves including petiole 5–8 cm; petiole 1–2 cm, both petiole and rachis densely covered with appressed hairs 0.2–0.6 mm. Leaflets opposite, in 5 to 7 pairs, narrowly elliptic to elliptic, 8–18 × 1–2 mm, acuminate at apex, pungent, with a cusp 1–1.5 mm, on both sides loosely covered with appressed to subappressed hairs to 0.8 mm, sometimes glabrescent, terminal leaflets modified to a spine. Inflorescence a terminal raceme; peduncles 0.5–2.5 cm, shorter than the leaves, densely covered with tangled spreading hairs to 2 mm. Racemes globose to ovoid, 2.5–4.5 × 2–3 cm, densely many-flowered. Bracts mostly persistent, membranous, yellowish, ovate to lanceolate, acuminate at apex, 11–15 × 3–6 mm, at the upper part purple to violet, at the base and middle rib rather densely to loosely appressed hairy, ciliate at margins. Calyx inflated, 13–16 × 5–6 mm, whitish yellow, purple at apex, densely covered with ascending to spreading hairs to 2.5 mm mixed with short hairs; teeth subulate, 4–6 mm, purplish. Petals violet, claws yellowish. Standard 16–18 mm; blade 4–6 mm wide, acute at apex, hastate-auriculate at base, below the middle slightly constricted, gradually narrowed into the rather wide claw. Wings ca. 15 mm; blade oblong to elliptic, obtuse at apex, 7 × 2 mm; auricle ca. 0.5 mm; claw 8–9 mm. Keel petals 12–13 mm; blade obliquely obovate, subacute, 4–4.5 × 2–2.5 mm; auricle indistinct; claw 8–9 mm. Keel and claws of wings adnate to staminal tube for 0.5 mm. Stamens 13–15 mm, diadelphous, 9 + 1, connate stamens free in upper 2–2.5 mm. Ovary ca. 6 mm, sessile, hairy. Legumes unknown.

Etymology. The specific epithet *dejectus* refers to the small size of the new taxon.

Discussion. *Astragalus dejectus* is a rare local endemic growing on rocky slopes of Gheydar Mountain in Gheydar, Zanjan Province. Its probable closest relative is *A. qorvehensis* Podlech, which is also an endemic species of western Iran, Hamadan

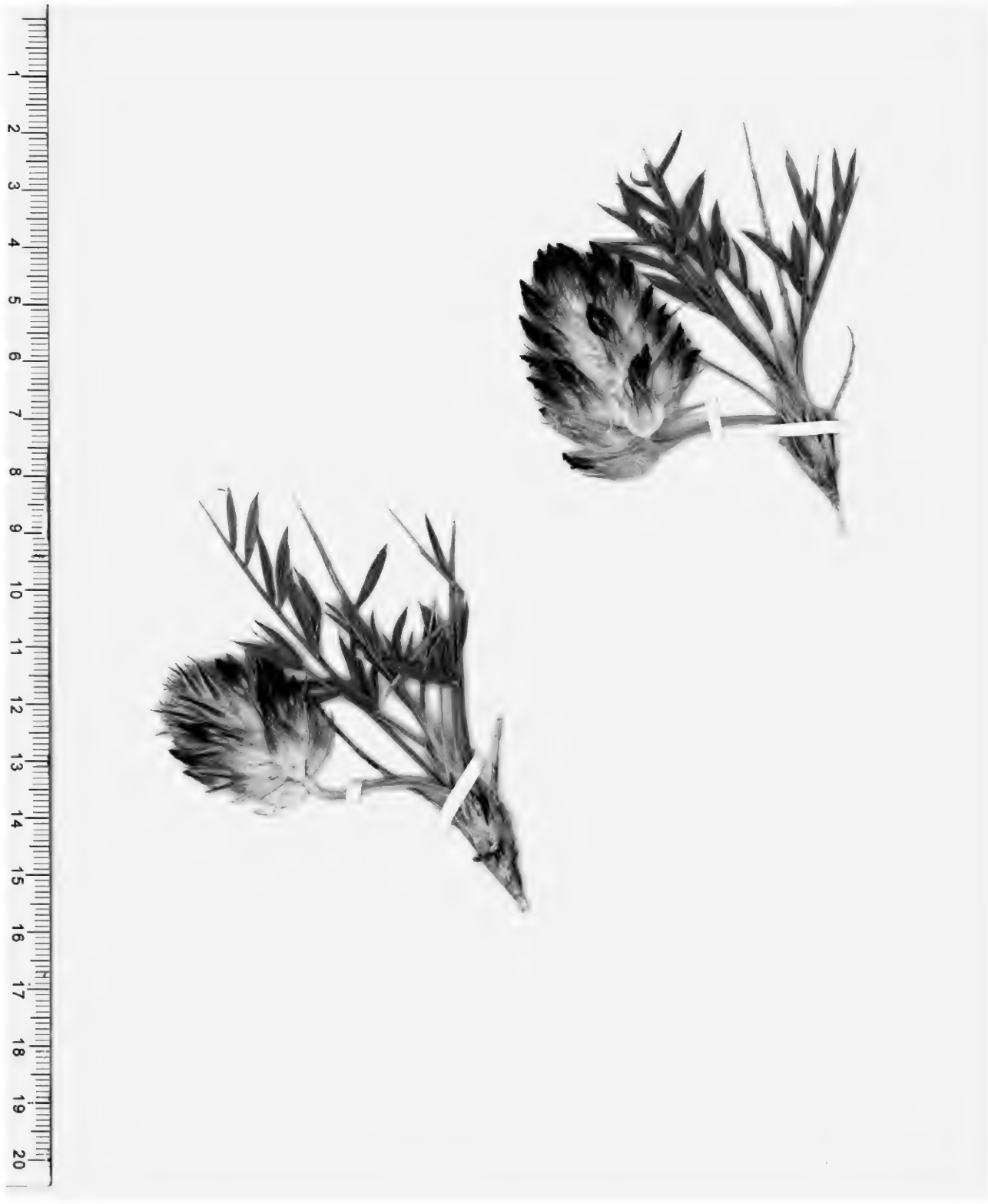

Figure 3. *Astragalus dejectus* Maassoumi, F. Ghahrem. & Bagheri. Photographed from the holotype, *Bagheri 9079* (T).

Province. There are several morphological characters to distinguish these species from each other including the following: *A. dejectus* has longer stipules; a long adnate part to the petiole; peduncles that are shorter than the leaves; longer bracts; and an acute (vs. rounded) standard apex.

4. Astragalus mostafa-assadii Bagheri, Maassoumi, F. Ghahrem. & Podlech, sp. nov. TYPE: Iran. Zanjan: 15 km from Abhar to Gheydar, 1940 m, 19 May 2009 (fl.), *Bagheri 6628* (holotype, TARI!; isotypes, FAR!, HUI!, MSB!, T!, TARI!). Figure 4.

Haec species ab *Astragalo straussii* Hausskn. ex Bornm. foliorum petiolo rhachideque trichomatibus appressis tantum (nec appressis et ascendentibus vel patentibus mixtis) obtectis, pedunculis ca. 15 (nec 3–11) cm longis et bracteis glabris plerumque persistentibus; ab *A. chehreganii* Zarre & Podlech foliolis 4- ad 6- (nec 7- ad 9-) jugis, racemis ovoideis vel cylindraceis (nec globosis) ca. 6 × 2–3 (nec 3–3.5 × 3–4) cm, calyce purpureo-violaceo (nec pallide flavido dentibus saepe purpureis) et vexillo ca. 23 (nec 16–19) mm longo; ab ambobus bracteis chartaceis (nec membranaceis) differt.

Plants subshrubs, caespitose, to 26 cm tall. Stems in the older parts ligneous, to 2.5 cm, branching from the base and covered with brownish bark and remnants of old petioles and stipules; younger stems in the current year ca. 1.5 cm. Stipules hyaline-membranous, ca. 17 mm, triangular-acuminate, adnate to the petiole for 9 mm, very shortly connate, glabrous. Leaves including petiole 6–10 cm; petiole to 4 cm, both petiole and rachis densely covered with appressed hairs 0.5–0.8 mm. Leaflets opposite, in 4

Figure 4. *Astragalus mostafa-assadii* Bagheri, Maassoumi, F. Ghahrem. & Podlech. Photographed from the holotype, *Bagheri 6628* (TARI).

to 6 pairs, elliptic, 8–20 × 2–3 mm, acuminate at apex, pungent, with a cusp 0.5–1 mm, on both sides densely covered with appressed hairs to 0.6 mm, terminal leaflets modified to a spine. Inflorescence a terminal raceme; peduncle ca. 15 cm, densely covered with ascending to spreading, long hairs to 2.5 mm mixed with short, appressed hairs to 0.5 mm, rarely glabrescent in the middle part. Racemes semicylindrical, 6 × 2–3 cm, densely many-flowered. Bracts mostly persistent, widely ovate, chartaceous, acuminate at apex, 13–15 × 4–7 mm, glabrous. Calyx inflated, ca. 18 mm, purplish to violet, densely covered with ascending to spreading hairs to 3 mm mixed with short hairs to 0.5 mm; teeth subulate, violet, ca. 6 mm. Petals violet to purplish, in the lower part pale yellowish, glabrous. Standard ca. 23 mm; blade 8 mm wide, rounded at apex, hastate-auriculate at base, below the middle slightly constricted, gradually narrowed into the rather wide claw. Wings ca. 21 mm; blade oblong, rounded at apex, 8 × 3 mm; auricle very short, indistinctive; claw ca. 13 mm. Keel petals ca. 17 mm; blade obliquely obovate, 6 × 3 mm; auricle indistinct; claw ca. 12 mm. Keel and claws of wings adnate to staminal tube for 0.5–1 mm. Stamens ca. 18 mm, diadelphous, 9 + 1, connate stamens free in upper 4–6 mm. Ovary 5–6 mm, sessile, appressed hairy. Legumes unknown.

Etymology. The specific epithet *mostafa-assadii* was chosen in honor of Professor Dr. Mostafa Assadi, a famous Iranian botanist.

Discussion. *Astragalus mostafa-assadii* resembles *A. straussii* Hausskn. ex Bornm. and *A. chehreganii* Zarre & Podlech in having globose to ovoid inflorescences but differs from *A. straussii* by having longer peduncles and bracts that are mostly persistent, chartaceous, and glabrous (vs. partly caducous, membranous, and ciliate at the margins). It differs from *A. chehreganii* by having fewer leaflets per leaf, chartaceous (vs. membranous) bracts, a violet to purple (vs. yellowish) calyx, and a longer standard. The new species is endemic to northwestern Iran, occurring in the mountains between Geydar and Abhar in Zanjan Province. The two similar taxa are distributed in northwestern and western Iran.

5. Astragalus paralurgiformis F. Ghahrem., Maassoumi & Bagheri, sp. nov. TYPE: Iran. Zanjan: Gheydar, Gheydar Mt., 2220 m, 5 June 2009 (fl.), *Bagheri 8829* (numbered *8830* in MSB) (holotype, T!; isotypes, MSB!, TARI!). Figure 5.

Haec species ab *Astragalo paralurgidi* Bunge foliis usque ad 4 (nec 1–2) cm longis, foliolis 6- vel 7- (nec 2- ad 4-) jugis, 7–13 (nec 4–8) mm longis differt.

Plants subshrubs, caespitose, 20–25 cm tall. Stems in the older parts ligneous, to 3 cm, branching from the base and covered with blackish bark and remnants of old petioles and stipules; younger stems in the current year ca. 1 cm. Stipules membranous, hyaline at apex, 6–10 mm, lanceolate-acuminate, adnate to the petiole for 3–5 mm, very shortly connate, glabrous. Leaves including petiole to 4 cm; petiole ca. 1 cm, both petiole and rachis densely covered with appressed hairs 0.5 mm. Leaflets opposite, in 6 to 7 pairs, narrowly elliptic to lanceolate, 7–13 × 1–1.5 mm, acuminate, pungent, with a cusp 0.5–1 mm, on both sides densely covered with appressed hairs 0.5 mm, terminal leaflets modified to a spine. Inflorescence a terminal raceme; peduncle 5–6 cm, densely covered with subappressed to spreading hairs 1–2.5 mm. Racemes cylindrical, ca. 6 × 2–2.5 cm, loosely many-flowered, axis densely covered with ascending hairs to 2 mm. Bracts caducous, narrowly elliptic, membranous, acuminate, ca. 8 × 2 mm, glabrous, sparsely ciliate at the margins. Calyx inflated, ca. 17 mm, whitish to creamy with purplish to rose nerves, densely covered with ascending to spreading hairs to 3.5 mm; teeth subulate, greenish to purplish, 6–8 mm. Petals purplish to violet or rose to greenish, glabrous. Standard ca. 20 mm; blade 6–7 mm wide, slightly mucronulate at apex, hastate-auriculate at base, below the middle slightly constricted, gradually narrowed into the rather wide claw. Wings 17–18 mm; blade narrowly oblong, acute at apex, 8–9 × 2–3 mm; auricle ca. 0.5 mm; claw ca. 10 mm. Keel petals ca. 15 mm; blade obliquely obovate, subacute at apex, 5 × 3 mm; auricle indistinct; claw ca. 10 mm. Keel and claws of wings adnate to staminal tube for 0.5 mm. Stamens ca. 16 mm, diadelphous, 9 + 1, connate stamens free in upper 3–4 mm. Ovary 5–6 mm, sessile, hairy. Legumes unknown.

Etymology. The specific epithet *paralurgiformis* refers to the resemblance of the new species to *Astragalus paralurges* Bunge.

Discussion. *Astragalus paralurgiformis* is an Irano-Turanian element that grows on rocky slopes of the Gheydar Mountain in the mid-montane zone. It is very similar to *A. paralurges*, a species distributed in the northwest and west of Iran. *Astragalus paralurgiformis* can be distinguished from *A. paralurges* by its longer leaves and leaflets and greater number of leaflets per leaf.

6. Astragalus pluriflorus F. Ghahrem., Maassoumi, Bagheri & Podlech, sp. nov. TYPE: Iran. Zanjan: 48 km from Mahneshan to Pari, 2900

Figure 5. *Astragalus paralurgiformis* F. Ghahrem., Maassoumi & Bagheri. Photographed from the holotype, *Bagheri 8829* (T).

m, 24 May 2009 (fl.), *Bagheri 6812* (holotype, TARI!; isotypes, MSB!, T!). Figure 6.

Haec species ab *Astragalo subrecognito* Bagheri, Maassoumi & F. Ghahrem. pedunculis 1.5–3 (nec 3–4) cm longis, racemis densifloris, bracteis plerumque persistentibus et vexillo 17–19 (nec 22–24) mm longo; ab *A. tabriziano* Buhse stipulis hyalino-membranaceis (nec chartaceis), pedunculis trichomatibus intertextis patentibus usque ad 3 (nec 0.2–1) mm longis dense obtectis, bracteis glabris (nec dense pilosis) et vexillo apice leviter acuminato (nec obtuso vel raro retuso) differt.

Plants subshrubs, caespitose, to 13 cm tall. Stems in the older parts ligneous, to 2.5 cm, branching from the base and covered with blackish bark and remnants of old petioles and stipules; younger stems in the current year ca. 1 cm. Stipules hyaline-membranous, ca. 18 mm, triangular-acuminate, adnate to the petiole for ca. 10 mm, ca. 5 mm connate, glabrous or ciliate at the margins. Leaves including petiole 3–7 cm; petiole 1–2 cm, both petiole and rachis densely covered with ascending to

Figure 6. *Astragalus pluriflorus* F. Ghahrem., Maassoumi, Bagheri & Podlech. Photographed from the holotype, *Bagheri 6812* (TARI).

spreading hairs 0.5–1 mm. Leaflets opposite, in 4 to 6 pairs, elliptic, 10–25 × 2–4 mm, acuminate, pungent, with a cusp 1–1.5 mm, on both sides densely covered with appressed to subappressed hairs to 0.8 mm, terminal leaflets modified to a spine. Inflorescence a terminal raceme; peduncle 1.5–3 cm, very densely covered with tangled, ascending hairs to 3 mm. Racemes globose to cylindrical, 3–7 × 2.5–3 cm, densely many-flowered. Bracts mostly persistent, broadly ovate, membranous, hyaline at the margins, acuminate at apex, 10–14 × 4–8 mm, glabrous. Calyx inflated, 16–18 mm, yellowish to creamy, with purplish to rose nerves, densely covered with tangled ascending to spreading hairs to 3.5 mm, mixed with very short hairs; teeth subulate, purplish, 4–10 mm. Petals yellowish to creamy, at the apex pale violet, glabrous. Standard 17–19 mm; blade 6–8 mm wide, oblong, slightly acuminate at apex, hastate-auriculate at base, below the middle slightly constricted, gradually narrowed into the rather wide claw. Wings

ca. 18 mm; blade oblong, 8 × 2 mm; auricle ca. 0.5 mm; claw ca. 10 mm. Keel petals ca. 17 mm; blade obliquely obovate, subacute at apex, 7 × 3 mm; auricle indistinct; claw ca. 9 mm. Keel and claws of wings adnate to staminal tube for 0.5–1 mm. Stamens ca. 15 mm, diadelphous, 9 + 1, connate stamens free in upper 2–4 mm. Ovary 5–6 mm, sessile, appressed hairy. Legumes unknown.

Etymology. The specific epithet *pluriflorus* refers to the dense inflorescence of the new species.

Discussion. *Astragalus pluriflorus* is an endemic species of northwestern Iran in the Mahneshan Region. It grows on the mountains around Pari Village. It is most similar to *A. subrecognitus* Bagheri, Maassoumi & F. Ghahrem. and *A. tabrizianus* Buhse but is easily distinguishable by morphological features. It differs from *A. subrecognitus* by having longer peduncles, dense (vs. lax) inflorescences, and mostly persistent (vs. caducous) bracts. It differs from *A. tabrizianus* in having hyaline to membranous (vs. chartaceous) stipules, longer hairs on peduncles, and glabrous (vs. pubescent) bracts. All of these species are endemic to northwestern Iran; *A. tabrizianus* has a wide distribution in this area, while *A. pluriflorus* and *A. subrecognitus* are local endemics of Zanjan Province.

7. **Astragalus pseudoparalurges** F. Ghahrem., Maassoumi, Bagheri & Podlech, sp. nov. TYPE: Iran. Zanjan: Gheydar, Yenghikand, 2060 m, 7 June 2009 (fl.), *Bagheri 8865* (holotype, TARI!; isotypes, MSB!, T!). Figure 7.

Haec species ab *Astragalo paralurgidi* Bunge stipulis glabris (nec saepissime minute glandulari-marginatis), foliis 7–13 (nec 10–20) mm longis et calyce petalisque flavidis (nec purpureo-violaceis) differt.

Plants subshrubs, caespitose, 7–9 cm tall. Stems in the older parts ligneous, to 2 cm, branching from the base and covered with blackish bark and remnants of old petioles and stipules; younger stems in the current year very short. Stipules membranous, hyaline at apex, ca. 10 mm, lanceolate-acuminate, adnate to the petiole for 5 mm, very shortly connate, glabrous. Leaves including petiole 7–13 mm; petiole 3–5 mm, both petiole and rachis densely covered with appressed hairs 0.5 mm. Leaflets opposite, in 3 to 4 pairs, narrowly elliptic, 3–7 × 0.5–1 mm, acuminate at apex, pungent, with a cusp ca. 0.5 mm, on both sides densely covered with appressed hairs to 0.7 mm, terminal leaflets modified to a spine. Inflorescence a terminal raceme; peduncle 1–3.5 cm, densely covered with subappressed to spreading hairs 1–1.5 mm. Racemes ovoid to cylindrical, 3–4.5 × 2–2.5 cm, loosely many-flowered, axis densely covered with spreading to ascending hairs to 1.5 mm. Bracts falling, narrowly elliptic, membranous, acuminate at apex, ca. 10 × 4 mm, glabrous. Calyx inflated, ca. 14 mm, yellowish to creamy, densely covered with ascending hairs to 4.5 mm; teeth subulate, yellowish, 6–8 mm. Petals yellowish, glabrous. Standard ca. 17 mm; blade 5–6 mm wide, slightly mucronulate at apex, hastate-auriculate at base, below the middle slightly constricted, gradually narrowed into the rather wide claw. Wings 15–16 mm; blade oblong, 7–8 × 2–3 mm; auricle ca. 0.5 mm; claw 8–9 mm. Keel petals ca. 13 mm; blade obliquely obovate, subacute at apex, 4 × 3 mm; auricle indistinct; claw ca. 9 mm. The claws of the wings and the keel are adnate to the staminal tube for 0.5 mm. Ovary 6–7 mm, sessile, hairy. Stamens ca. 16 mm, diadelphous, 9 + 1, connate stamens free in upper 3–4 mm. Legumes unknown.

Etymology. The specific epithet *pseudoparalurges* refers to the resemblance of the new species to *Astragalus paralurges*.

Discussion. *Astragalus paralurges* is the existing species most similar to *A. pseudoparalurges*, although there are important differences between them, including the color of calyces, teeth, and petals, which are yellow in *A. pseudoparalurges* versus violet to purple in *A. paralurges*; also, the stipules of *A. pseudoparalurges* are glabrous rather than glandular-margined. Both species are endemic to Iran. *Astragalus pseudoparalurges* is distinguished from *A. paralurgiformis* by having yellow calyces, teeth, and petals (vs. purplish to violet or rose) and shorter leaves with fewer leaflets per leaf.

8. **Astragalus sohrevardianus** Bagheri, Maassoumi & F. Ghahrem., sp. nov. TYPE: Iran. Zanjan: Gheydar, Karasf to Sohrevard, 2120 m, 6 July 2009 (fl.), *Bagheri 8846* (holotype, TARI!; isotypes, MSB!, T!). Figure 8.

Haec species ab *Astragalo melanosticto* Freyn foliolis 6- ad 9- (nec 5- ad 7-) jugis, bracteis hyalino-membranaceis (nec chartaceis), calyce trichomatibus usque ad 3.5 (nec 1–2.5) mm longis dense obtecto et vexillo acuminato; ab *A. marivanensi* Maassoumi & Podlech pedunculis trichomatibus appressis vel subappressis (nec adscendentibus vel patentibus) dense obtectis, bracteis plerumque persistentibus et calycis dentibus ca. 6 (nec 8–10) mm longis; ab ambobus petalis longioribus differt.

Plants subshrubs, caespitose, to 30 cm tall. Stems in the older parts ligneous, to 2.5 cm, branching from the base and covered with brownish bark and remnants of old petioles and stipules; younger stems in the current year ca. 2 cm. Stipules hyaline-

Figure 7. *Astragalus pseudoparalurges* F. Ghahrem., Maassoumi, Bagheri & Podlech. Photographed from the holotype, *Bagheri 8865* (TARI).

membranous, ca. 18 mm, triangular-acuminate, adnate to the petiole for 8 mm, 3 mm connate, glabrous. Leaves including petiole 6–10 cm; petiole 2.5–4 cm, both petiole and rachis densely covered with ascending to spreading hairs to 1 mm. Leaflets opposite, in 6 to 8 pairs, elliptic, 13–16 × 3–5 mm, acuminate at apex, pungent, with a cusp 1–1.5 mm, on both sides densely covered with ascending to spreading hairs to 1 mm, terminal leaflets modified to a spine. Inflorescence a terminal raceme; peduncle 16–19 cm, densely covered with appressed to subappressed, long hairs to 2 mm mixed with very short, appressed hairs to 0.5 mm, sometimes glabrescent. Racemes cylindrical, 7–9 × 2–2.5 cm, densely many-flowered. Bracts mostly persistent, widely ovate, membranous, hyaline at the margins,

Figure 8. *Astragalus sohrevardianus* Bagheri, Maassoumi & F. Ghahrem. Photographed from the holotype, *Bagheri 8846* (TARI).

acuminate at apex, 13–16 × 5–8 mm, glabrous, very sparsely hairy at the apex. Calyx inflated, 16–18 mm, yellowish to creamy, densely covered with tangled, ascending to spreading hairs to 3.5 mm; teeth subulate, yellowish, ca. 6 mm. Petals yellow to pale yellowish or pale whitish, glabrous. Standard ca. 25 mm; blade 6–7 mm wide, slightly acuminate at apex, sharply hastate-auriculate at base, below the middle slightly constricted, gradually narrowed into the rather wide claw. Wings ca. 22 mm; blade oblong, acute at apex, 10 × 3 mm; auricle ca. 1 mm; claw ca. 13 mm. Keel ca. 21 mm; blade obliquely obovate, subacute at apex, 8 × 3 mm; auricle indistinct; claw ca. 8 mm. Keel and claws of wings adnate to staminal tube for 0.5–1 mm. Stamens ca. 20 mm, diadelphous, 9 + 1, connate stamens free in upper 3–5 mm. Ovary

6–7 mm, sessile, appressed hairy. Legumes unknown.

Etymology. The specific epithet *sohrevardianus* refers to the type locality of the new species from Sohrevard in Zanjan Province.

Discussion. *Astragalus sohrevardianus* is a very rare, locally endemic species found in a small area close to Sohrevard Village in Gheydar, Zanjan Province, while the most similar taxa, *A. melanostictus* Freyn and *A. marivanensis* Podlech & Maassoumi, have a much wider distribution. The first species occurs in northeastern Iraq as well as northwestern and western Iran, and the latter is distributed in northeastern Iraq, eastern Turkey, and northwestern and western Iran. These species share some characters with *A. sohrevardianus*, such as yellow petals, but the new species differs from *A. melanostictus* by having a greater number of leaflets per leaf, hyaline to membranous (vs. chartaceous) bracts, longer hairs on the calyx, longer and acuminate (vs. short and rounded) standard, and longer wings and keel petals. It differs from *A. marivanensis* by having appressed to subappressed (vs. ascending to spreading) hairs on the peduncles, mostly persistent (vs. partly caducous) bracts, shorter calyx teeth, and longer standard, wings, and keel petals.

9. Astragalus sublaguriformis Bagheri, Maassoumi & F. Ghahrem., sp. nov. TYPE: Iran. Zanjan: 72 km from Zanjan to Mahneshan, 2120 m, 7 July 2009 (fl.), *Bagheri 8953* (holotype, TARI!; isotypes, MSB!, T!). Figure 9.

Haec species ab *Astragalo tabriziano* Buhse foliolorum mucrone usque ad 3.5 (nec 0.5–1) mm longo, bractearum mucrone rubro (nec flavo) 9–11 (nec 1–5) mm longo et calyce trichomatibus longis brevibusque mixtis obtecto; ab *A. laguriformi* Freyn pedunculis trichomatibus ascendentibus vel patentibus (nec appressis vel subappressis) dense obtectis et bracteis dense pilosis; ab ambobus stipulis longioribus differt.

Plants subshrubs, caespitose, to 10 cm tall. Stems in the older parts ligneous, to 3 cm, branching from the base and covered with pale brownish bark and remnants of old petioles and stipules; younger stems in the current year ca. 1.5 cm. Stipules chartaceous, 19–20 mm, lanceolate, adnate to the petiole for 10 mm, very shortly connate, younger parts sparsely appressed hairy, becoming glabrous with age, ciliate at the margins. Leaves including petiole 5–6 cm; petiole 2–2.5 cm, both petiole and rachis densely covered with appressed hairs to 0.4 mm. Leaflets opposite, in 4 to 5 pairs, oblong-lanceolate, 15–27 × 2–3 mm, acuminate at apex, pungent, with cusp to 3.5 mm, on both sides densely covered with appressed hairs 0.2–0.6 mm, terminal leaflets modified to a spine. Inflorescence a terminal raceme; peduncles 1–2.5 cm, shorter than the leaves, densely covered with tangled, spreading hairs to 1.5 mm. Racemes oblong, 4–5 × ca. 2.5 cm, densely many-flowered. Bracts mostly persistent, chartaceous, yellowish, widely ovate to elliptic, acuminate-aristate at apex, 13–15 × 2.5–3.5 mm, with a reddish cusp 9–11 mm, densely covered with appressed to subappressed hairs 0.4–0.8 mm, ciliate at the margins. Calyx inflated, 15–17 × 6.5–7.5 mm, pale yellowish to creamy, rarely with purplish nerves at the apex, densely covered with ascending to spreading hairs to 3 mm mixed with short hairs to 0.5 mm; teeth subulate, brownish to purplish, 7–8 mm. Petals violet to purple. Standard 15–16 mm; blade 5–6 mm wide, rounded, slightly mucronulate at apex, obtusely hastate-auriculate at base, below the middle slightly constricted, gradually narrowed into the rather wide claw. Wings ca. 15.5 mm; blade oblong to elliptic, obtuse at apex, 5–5.5 × 1.5–2 mm; auricle ca. 0.5 mm; claw 9–10 mm. Keel petals 13–13.5 mm; blade obliquely obovate, subacute at apex, ca. 5 × 2.5–3 mm; auricle indistinct; claw 7.5–8 mm. Keel and claws of wings adnate to staminal tube for 0.5 mm. Stamens 14–16 mm, diadelphous, 9 + 1, connate stamens free in upper 2–3 mm. Ovary 4.5–5 mm, sessile, hairy. Legumes unknown.

Etymology. The specific epithet *sublaguriformis* refers to the resemblance of the new species to *Astragalus laguriformis* Freyn.

Discussion. *Astragalus sublaguriformis* resembles *A. tabrizianus* and *A. laguriformis*. It differs from *A. tabrizianus* by having longer stipules, longer cusps on leaflets, and much longer, reddish (vs. yellowish) cusps on bracts. It is distinguished from *A. laguriformis* by having much longer stipules, ascending to spreading (vs. appressed to subappressed) hairs on peduncles, and densely hairy (vs. sparsely hairy) bracts. *Astragalus sublaguriformis* is an endemic to the Mahneshan Region in Zanjan Province of northwestern Iran, while the two other species are widely distributed in northwestern and western Iran; *A. laguriformis* also occurs in northeastern Iraq.

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Figure 9. *Astragalus sublaguriformis* Bagheri, Maassoumi & F. Ghahrem. Photographed from the holotype, *Bagheri 8953* (TARI).

access to type materials. We also thank the University of Isfahan and Kharazmi University for their support of this work.

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A New Species of *Styrax* (Styracaceae) from Peru

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Abstract. A new species of *Styrax* L. from the region of Cusco, Peru, is described and illustrated. *Styrax excelsus* P. W. Fritsch belongs to *Styrax* subser. *Foveolaria* (Ruiz & Pav.) P. W. Fritsch through its flowers shorter than or up to 10 mm; number of stamens equal to the number of petals (five); near-basal placentation; three ellipsoid ovules per flower (i.e., one per carpel); and presence of only female flowers, which suggests a gynodioecious breeding system. It is similar to *S. maninul* B. Walln. but differs by its taller habit; abaxial surface of the leaf blade with ferruginous, stellate trichomes that are generally smaller but with more arms and prominent reticulate tertiary veins; acute or slightly acuminate leaf apex; shorter inflorescences with fewer flowers; a longer corolla; and narrower staminodial pseudoanthers. The new species is only known from the type.

Key words: Cusco, IUCN Red List, Peru, Styracaceae, *Styrax*.

Styrax L. ser. *Valvatae* Perkins comprises about 80 species distributed throughout the Neotropics. Most species of the series possess a hermaphroditic breeding system with bisexual flowers, but 10 are known or likely to have a gynodioecious breeding system. Nine of these form a clade that is sister to a clade of the remaining members of the series (Fritsch, 2001, 2003; Fritsch et al., 2015); these two clades have been recently recognized taxonomically as *Styrax* subser. *Foveolaria* (Ruiz & Pav.) P. W. Fritsch and *Styrax* subser. *Latifolii* P. W. Fritsch, respectively (Fritsch et al., 2015). In addition to the difference in breeding system, the species of *Styrax* subser. *Foveolaria* are generally distinguishable from those of *Styrax* subser. *Latifolii* by flowers shorter than or up to 10 mm (vs. generally longer than 10 mm). Most members of *Styrax* subser. *Foveolaria* also uniquely share an anther number that is equal to the number of petals (vs. twice the number of petals), near-basal placentation (vs. axile), three ovules per flower (i.e., one ovule per carpel vs. usually five to eight per carpel), and ovules ellipsoid (vs. discoid) (Wallnöfer, 1997; Fritsch, 1999, 2004; Fritsch et al. 2015).

Several years ago, a duplicate specimen of a *Styrax* species collected in Peru in 2006 was sent on exchange from the Missouri Botanical Garden to the California Academy of Sciences for species determination. On examination of this specimen, I was able to ascertain that it was easily placed within *Styrax* subser. *Foveolaria* by the presence of only female flowers (suggesting gynodioecy), flowers shorter than or up to 10 mm, number of stamens equal to the number of petals (five), near-basal placentation, and three ellipsoid ovules per flower. Several distinctive characters of the specimen indicated that the collection represents a species new to science, which is here described and illustrated.

Styrax excelsus P. W. Fritsch, sp. nov. TYPE: Peru. Cusco: Prov. La Convención, Distr. Quelloúno, Lacco, 12°37′31″S, 72°14′03″W, 2770 m, 17 June 2006 (fl.), *L. Valenzuela, J. Farfán, E. Suclli & J. Farfán F. 6917* (holotype, CAS!; isotypes, AMAZ not seen, CUZ not seen, HUT not seen, MO-6154262 [barcode] 2154636 image!, MOL not seen, USM not seen). Figure 1.

Haec species *Styraci maninul* B. Walln. simillima, sed ab eo habitu excelsiore, lamina foliari abaxialiter trichomatibus ferrugineis stellatis plerumque minoribus sed cum pluribus brachiis induta ac venis tertiariis prominentibus reticulatis praedita, laminae apice acuto vel leviter acuminato, inflorescentiis brevioribus paucifloris, corolla longiore atque pseudoantheris staminodialibus angustioribus differt.

Tree, evergreen, 25 m tall; young branchlets densely tomentose with ferruginous, stellate trichomes. Petioles 8–12 mm; leaf domatia absent; leaf blades elliptic, 4.9–7.6 × 2.3–3.1 cm, 2–2.5 times as long as wide, subcoriaceous, abaxially densely tomentose with minute, greenish white, stellate trichomes and larger, evenly scattered, ferruginous, stellate trichomes of various sizes to 0.6 mm (those on midvein to 0.8 mm) and with 8 to 25 arms, adaxially with evenly scattered, yellow to golden brown, stellate trichomes, base cuneate to subrounded, margin entire, planar to slightly revolute, apex acute to slightly acuminate, midvein raised abaxially, impressed adaxially, secondary veins 8 to 10 on each

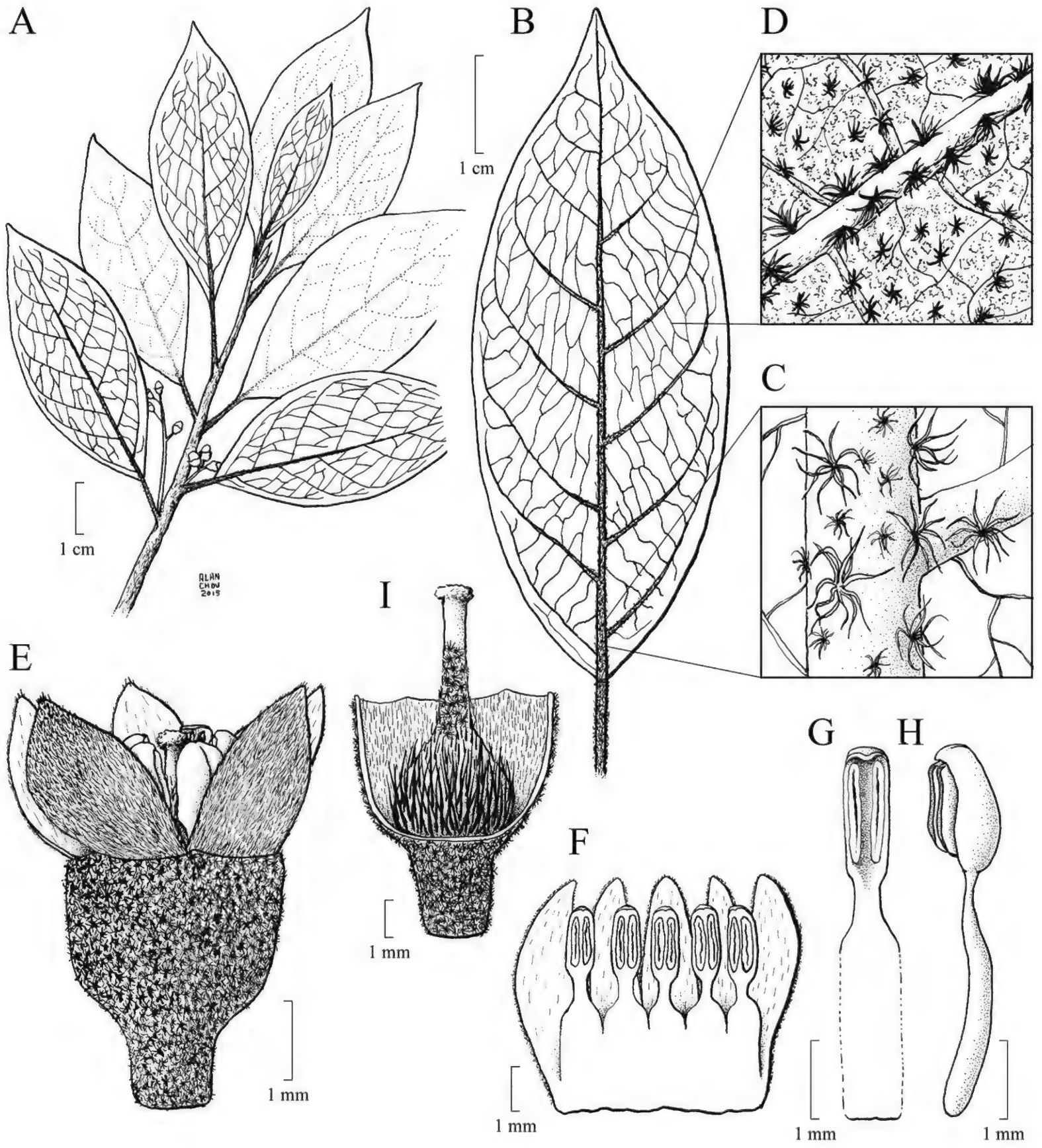

Figure 1. *Styrax excelsus* P. W. Fritsch. —A. Branchlet with inflorescences. —B. Leaf, abaxial side. —C. Close-up of abaxial side of leaf blade showing stellate trichomes at junction of midvein and secondary veins. —D. Close-up of abaxial side of leaf blade showing stellate trichomes at junction of secondary and tertiary veins. —E. Flower. —F. Corolla and pseudoandroecium, opened to show inner features. —G. Staminode, ventral view (including basal portion adnate to corolla; connation to adjacent staminodes indicated as dashed line). —H. Staminode, lateral view (including basal portion adnate to corolla). —I. Calyx partially cut away to show complete gynoecium. Drawn from the holotype *L. Valenzuela, J. Farfán, E. Suclli & J. Farfán F. 6917* (CAS).

side of midvein, raised abaxially, slightly impressed adaxially, tertiary and quaternary veins abaxially prominent, their surfaces visible through the pubescence. Inflorescences axillary, raceme-like, 2.5–3.2 cm, 7- to 10-flowered, densely tomentose with ferruginous, stellate trichomes; rachis 1.2–2 cm; pedicels 1–1.5 mm. Hermaphrodite flowers unknown. Female flowers 5–6 mm; calyx cupuliform, 2–2.3 × 2.5–3 mm, densely tomentose with ferruginous, stellate trichomes, margin concave between minute teeth, inner margin not glandular; trichomes at mid-calyx with arms to 0.25 mm; corolla 4.2–5.2 mm; corolla tube extending to calyx margin, 1–1.5 mm; corolla lobes 5, spreading, subcoriaceous, 3–4 × 0.6–1 mm; staminodes 5; free portion of staminodial tube 0.7–1 mm, glabrous or sparsely stellate-pubescent

abaxially; distinct portion of staminodial filaments planar, without ridges, 0.3–0.4 mm, glabrous; pseudoanthers 1.3–1.7 × 0.25–0.5 mm, pseudoconnectives ca. 1.5 times as wide as pseudothecae in tangential view, glabrous; pseudothecae linear, 1.1–1.4 mm, glabrous, apically non-tapered, exceeded by connective; free portion of ovary conical, base covered with greenish white scales, apex densely covered by yellowish, sparsely branched trichomes with arms strongly upward-pointing and to 0.6 mm; style filiform but slightly widening toward base, lower 2/3 covered by stellate trichomes with arms to 0.1 mm, upper 1/3 glabrous; stigma truncate, slightly wider than style. Placentation near-basal; ovules 3, 1 per carpel, ellipsoid. Fruit unknown.

Distribution, habitat, and phenology. *Styrax excelsus* has been found only in primary wet forest of Quelloúno District, La Convención Province, Cusco Region, Peru, at 2770 m elevation. The locality lies near the top of a ridge between the Yanatili and Yavero (Yayero, Paucartambo) Rivers, both tributaries of the Urubamba River. The only collection known was flowering in June.

IUCN Red List category. Because *Styrax excelsus* is known only from the type collection, I categorize this species as Data Deficient (DD), according to IUCN Standards and Petitions Subcommittee (2016) criteria. It is not located in any of the national protected areas of Peru (Solano, 2010). The locality of the new species lies ca. 20 km southeast and east of Sanctuario Nacional Megantoni and Manu National Park, respectively.

Etymology. The epithet *excelsus* refers to the tall height of the species in comparison with the rest of the species of *Styrax* subser. *Foveolaria*.

Discussion. *Styrax excelsus* can be distinguished from all other species of *Styrax* subser. *Foveolaria* by its habit alone, being a tree 25 m tall according to the label information (vs. shrubs or trees, typically 4–7[–10] m). In Wallnöfer's (1997) key to the species of *Styrax* with the number of stamens equal to the number of anthers (usually five; treated in Wallnöfer [1997] as *Styrax* sect. *Pamphilia* (Mart. ex A. DC.) B. Walln.; = *Styrax* subser. *Foveolaria* in part), *S. excelsus* would key best to *S. maninul* in having abaxial surfaces of mature leaves covered with a dense and persistent indumentum of stellate trichomes (vs. glabrous) and indumentum on abaxial leaf surfaces not homogeneous (vs. homogeneous). From the description of *S. maninul* in Wallnöfer (1997) and the examination of several specimens of this species on loan to me at BRIT from CAS and other herbaria, including those of flowering female individuals, the new species is easily distinguished from *S. maninul* by several morphological characters, in addition to the plant height. The abaxial leaf surfaces of the new species have generally smaller ferruginous trichomes (many more trichomes with arms < 0.6 mm) but with more arms (eight to 25, vs. usually < 10 in *S. maninul*) and tertiary veins on the leaf blade abaxially prominent (vs. slightly raised), leaf apex acute or slightly acuminate (vs. obtuse or occasionally shortly acute), inflorescences 2.5–3.2 cm and 7- to 10-flowered (vs. 4–6 cm and ca. 20-flowered), corolla of female flowers 4.2–5.2 mm (vs. 3.8–4 mm), and pseudoanthers 0.25–0.5 mm wide (vs. ca. 1 mm wide). Of the other species of *Styrax* subser. *Foveolaria*, the new species is geographically closest to *S. vilcabambae* (D. R. Simpson) B. Walln. of the Sierra Vilcabamba, also in La Convención Province but ca. 150 km east of the new species locality. In addition to its taller habit, it is easily distinguished from *S. vilcabambae* by its abaxial leaf surfaces that are densely pubescent (vs. glabrous except in axils of secondary veins) and with reticulate tertiary veins prominent (vs. slightly raised), as well as its pedicels 1–1.5 mm (vs. 2–4 mm).

The new species is known only from female flowers: the flowers have stamen-like organs that produce no pollen and so these organs are considered staminodes. All species in *Styrax* subser. *Foveolaria* with gender dimorphism either have been documented as at least morphologically gynodioecious, i.e., they consist of individuals with either all bisexual flowers or all female flowers in populations, or are thought to be so, the uncertainty arising in species in which only female or only bisexual flowers are known that otherwise match the characters defining *Styrax* subser. *Foveolaria* (Wallnöfer, 1997; Fritsch, 1999, 2004; Fritsch et al. 2015). *Styrax excelsus* is presumably also gynodioecious rather than dioecious, but more observations of the populations of this species will need to be made to confirm its breeding system.

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Six New Species of *Argomuellera* (Euphorbiaceae) from Madagascar

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Abstract. Six new species of Madagascan *Argomuellera* Pax are recognized. *Argomuellera bilocularis* McPherson is unique in the genus in having a 2-locular ovary; *A. gillespieae* McPherson, restricted to the Manongarivo Massif, has leaves more than 6 cm wide and pistillate sepals less than 3 mm long; *A. integra* McPherson, from northern Madagascar, has small leaf blades (4–11 × 1–3.5 cm) with entire margins; *A. longistipula* McPherson, endemic to the Vohémar Region, has unusually long stipules (2–5[–7] mm); *A. oblanceolata* McPherson, from western and southwestern Madagascar, has small acuminate leaves with dentate margins; and *A. stenophylla* McPherson, from southwestern Madagascar, has small, unusually narrow leaves (5–13 × 0.5–1.7[–2] cm). *Argomuellera decaryana* (Leandri) J. Léonard is relegated to the synonymy of *A. perrieri* (Leandri) J. Léonard. A key to the 12 *Argomuellera* species of Madagascar and the Comoro Islands is presented.

Key words: *Argomuellera*, *Droceloncia*, Euphorbiaceae, Madagascar, *Pycnocoma*.

Argomuellera Pax (Euphorbiaceae; Acalyphoideae, Pycnocomeae), as currently recognized, is a genus of 11 (Govaerts et al., 2000; Webster, 2014) or 12 (Radcliffe-Smith, 2001) species distributed in continental Africa, the Comoro Islands, and Madagascar. From the closely related *Pycnocoma* Benth. and *Droceloncia* J. Léonard, it can be readily separated by its possession of stipules (which are absent in *Droceloncia*), embedded laminar glands that are numerous, circular, and less than 0.5 mm diam. (vs. few, elliptical, and more than 0.5 mm long in *Droceloncia*), stylodia adaxially papillose throughout their length (vs. papillose only distally in *Pycnocoma* and *Droceloncia*), ovaries and fruits without appendages (vs. appendages present in *Pycnocoma*), and (in most species) bisexual inflorescences with both terminal and lateral pistillate flowers (vs. pistillate flowers solitary and terminal in *Droceloncia* and *Pycnocoma*, as well as in a few species of *Argomuellera*).

Six new species from Madagascar are here described, while one species that was recognized in the most recent treatment of the relevant taxa for the region (Leandri, 1941) is relegated to synonymy. A key to the resultant 12 species known from Madagascar and the Comoro Islands is provided.

1. Argomuellera bilocularis McPherson, sp. nov. TYPE: Madagascar. Antsiranana: Ramena, Ambodivahibe, forêt littorale d'Ampio, 12°23′04″S, 49°26′23″E, 10 m, 19 May 2005, *R. Ramananjanahary, F. Ratovoson, J. Be & Jaotoly 317* (holotype, P [barcode] P04763948!; isotypes, MO-6144090!, TAN not seen). Figure 1.

Diagnosis. *Argomuellera bilocularis* McPherson is unique in *Argomuellera* Pax in having a 2-locular ovary; it can also be distinguished from other species in Madagascar and the Comoros on the basis of its combination of relatively thick twigs (leafy portions of stem 3.5–6 mm in diameter) and short inflorescences (3–4 cm) with solitary and terminal pistillate flowers.

Treelets 1–2 m tall. Leafy portions of stem appressed-pubescent, glabrescent, 3.5–6 mm diam.; leaves usually clustered near branch tips. Leaf blades obovate to lanceolate, 9–17.5 × 2.5–6.7 cm, base attenuate, apex obtuse or acute, margins subentire to shallowly toothed, abaxial surface appressed-pubescent at first, glabrescent, embedded glands visible on the abaxial surface, midrib essentially flush with the surface adaxially, raised abaxially, secondary veins 17 to 23 on each side of the midrib, evident. Petioles ca. 4–10 mm, merging evenly with leaf base, 2–2.5 mm wide at midpoint. Stipules broadly triangular, 1–1.5 mm, pubescent, often persistent. Inflorescences axillary, bisexual typically, with a single terminal pistillate flower, unbranched, 3–4 cm, rachis 1.5–2 mm diam., pubescent with subappressed hairs. Bracts 2–3 mm; bracteoles ca. 1 mm. Staminate flowers (known only in bud) lateral, pedicels 2 mm (in bud), pubescent; buds ca. 3 mm, 2.5 mm diam., appressed-pubescent; stamens ca. 75; globose central disk densely pubescent. Pistillate flowers (known only in young fruit) terminal, solitary, pedicels up to 3.5 mm, pubescent; sepals 4 to 5, 2.5–3(–6) mm, pubescent abaxially, apex acute; disk not observed (because of paucity of appropriate material for study); ovary 2-lobed, fused portion of the 2 stylodia ca. 1.5 mm, 2 recurved branches ca. 4 mm. Fruit (immature) 2-lobed, ca. 1.1 cm high, 1 cm wide, densely pubescent with both short and long hairs, the latter ca. 0.5 mm; seeds unknown.

Figure 1. Holotype specimen of *Argomuellera bilocularis* McPherson (*R. Ramananjanahary, F. Ratovoson, J. Be & Jaotoly 317*, P).

Habitat, distribution, and phenology. *Argomuellera bilocularis* grows in littoral forests of northernmost Madagascar at elevations up to 10 m. It has been collected in flower in May and in fruit in May and November.

Discussion. *Argomuellera bilocularis* is remarkable for its 2-parted ovary, but can also be recognized by its thick stems (3.5–6 mm diam.), short inflorescences (3–4 cm), solitary pistillate flower terminating the inflorescence, and distribution in the far north of Madagascar.

Paratypes. MADAGASCAR. **Antsiranana:** Anjamaribe, à l'Est d'Irodo, 12°38′51″S, 49°32′13″E, 5 m, s.d., *Be 28* (MO, P not seen, TAN not seen); Ramena, forêt de l'Orangéa, 12°14′20″S, 49°21′49″E, 13 m, s.d., *Rabenantoandro 575* (MO, P not seen, TAN not seen); Ambovomavo, à 1 km ouest d'Ambolobozobe, 12°31′13″S, 49°31′21″E, s.d., *Rakotonandrasana 1199* (MO, P not seen, TAN not seen).

2. Argomuellera gillespieae McPherson, sp. nov. TYPE: Madagascar. Diana Region: Antsiranana, Manongarivo Special Reserve, SSE of Beraty, Besinkara, 14°03′44″S, 48°15′51″E, 100 m, 23 Oct. 2012, *L. J. Gillespie, G. A. Levin, J. Andriantiana & W. M. Cardinal-McTeague 10657* (holotype, MO-6668575!; isotypes, CAN!, P not seen, TAN not seen). Figure 2.

Diagnosis. *Argomuellera gillespieae* McPherson can be separated from its congeners by the combination of relatively wide leaves (more than 6 cm) with many secondary veins (ca. 35 to 43 per side) and long unbranched sparsely pubescent inflorescences bearing several to many lateral pistillate flowers, these with short sepals (less than 3 mm long).

Treelets ca. 3 m tall. Leafy portions of stem sparsely appressed-pubescent at first, quickly glabrescent, 5–7 mm diam. Leaf blades oblanceolate, 25–63 × 6.2–12 cm, base narrowly cuneate-attenuate, apex acuminate, margins dentate, revolute basally, abaxial surface appressed-pubescent while immature, quickly glabrescent, embedded glands obscure but present on the abaxial surface, adaxial surface glabrous at maturity, midrib raised adaxially, more prominent abaxially, secondary veins ca. 35 to 43 on each side of the midrib, higher venation somewhat obscure. Petioles (0.8–)1.2–3 cm, ca. 3 mm diam. at mid-length, merging smoothly with base of blade, appressed-pubescent while immature, soon glabrate. Stipules 1 mm, triangular, caducous. Inflorescences axillary, bisexual, each fascicle typically of 1 pistillate flower plus 1 to several staminate flowers (additional reduced staminate flowers sometimes present); unbranched, (9–)15–35 cm, rachis 1–2.5 mm diam., sparsely appressed-puberulent. Bracts up to 1.5 mm, bracteoles up to 1 mm. Staminate flowers with pedicels 2–3 mm, sparsely pubescent; calyx splitting into 2 or 3 sepals, 2 × ca. 1 mm, sparsely pubescent abaxially, apically acute; stamens 28 to 33 in number, 2.5–3 mm, glabrous; globose central disk 1 mm diam., pubescent. Pistillate flowers with pedicels 1.5–3 mm, pubescent; sepals 5 to 7, 1–2 × 0.5–1 mm, appressed-pubescent abaxially, apex acute, disk annular, pubescent; ovary 3-lobed, 2 mm high, 3 mm diam., densely appressed-pubescent, fused portion of the 3 stylodia 1 mm, 3 recurved branches ca. 2 mm. Fruit unknown.

Habitat, distribution, and phenology. *Argomuellera gillespieae* is known only from forests in the Manongarivo Region of northern Madagascar, at elevations of 40–100 m. Flowers have been collected in October and November.

Etymology. *Argomuellera gillespieae* is named for my colleague and fellow student of the Euphorbiaceae Lynn J. Gillespie, among whose carefully made collections figure no fewer than three of the six specimens selected as types in this paper.

Discussion. *Argomuellera gillespieae* most closely resembles the rarely collected *A. danguyana* (Leandri) J. Léonard but has wider leaves (6.2–12 cm vs. up to 6 cm in *A. danguyana*), more secondary veins (35 to 43 vs. 20 to 28) on each side of the midrib, inflorescences only sparsely puberulent (vs. moderately pubescent), shorter inflorescence bracts (up to 1.5 mm vs. 2.5–3 mm) and a different distribution (Manongarivo Massif vs. eastern forest).

Paratypes. MADAGASCAR. **Antsiranana:** Ambanja, près du village d'Ambodimanga, Chute de l'Ambobaka, affluent de la Ramena, 13°46′S, 48°31′E, 40 m, s.d., *Callmander 288* (MO, P, TAN not seen); Sambirano, vallée de la Beandrona, à l'Est d'Ambanja, s.d., *Service Forestier (Capuron) 18927* (P).

3. Argomuellera integra McPherson, sp. nov. TYPE: Madagascar. Antsiranana: Daraina, forêt d'Ambilondomba, 13°10′S, 49°39′E, 230 m, 18 Dec. 2004, *L. Nusbaumer & P. Ranirison 1356* (holotype, MO-04800027!; isotypes, G!, P not seen, TAN not seen). Figure 3.

Diagnosis. *Argomuellera integra* McPherson can be separated from the other 3-carpellate *Argomuellera* species with small leaves (i.e., less than 20 × 6 cm) by its narrowly obovate-oblanceolate leaf blades (4–11 × 1–3.5 cm) with entire margins and obtuse to acute (not acuminate) apices and by its inflorescence, which often bears lateral pistillate flowers in addition to the terminal pistillate flower.

Small trees ca. 3 m tall. Leafy portions of stem appressed-pubescent, somewhat glabrescent, 1.5–2.5 mm diam.; leaves clustered near branch ends. Leaf blades narrowly obovate or narrowly oblanceolate, 4–11 × 1–3.5 cm, base attenuate-cuneate into petiole, apex usually obtuse, occasionally acute (but not acuminate), margins entire, both surfaces at least partially appressed-pubescent while immature but soon glabrescent, embedded glands usually visible on the abaxial surface, midrib somewhat raised on both surfaces, secondary veins 13 to 17 on each side of the midrib, somewhat raised on both surfaces, tertiary venation visible. Petioles merging evenly with leaf base, ca. 4–8 mm, ca. 1.5 mm wide at midpoint,

MISSOURI
BOTANICAL GARDEN
HERBARIUM
№ 6668575
MISSOURI BOTANICAL GARDEN
copyright reserved
0 1 2 3 4 5 6 7 8 9 10
cm
MADAGASCAR
EUPHORBIACEAE [147]
Argomuellera
Antsiranana: DIANA Region
Manongarivo Special Reserve. SSE of Beraty, Besinkara, valley between low ridge and Besinka Plateau, along trail to plateau. Edge of secondary forest and newly cleared area, with Ravenala.
14°03'44"S 048°15'51"E 100 m
Treelet 3 m, monoecious; inflorescences with staminate flowers below, pistillate above.
23 October 2012
Lynn J. Gillespie et al. 10657
MISSOURI BOTANICAL GARDEN HERBARIUM (MO)
Collectors:
Lynn J. Gillespie, Geoffrey A. Levin, Jacky Andriantiana &
W.M. Cardinal-McTeague 10657
TYPE SPECIMEN
Missouri Botanical Garden (MO)

Figure 2. Holotype specimen of *Argomuellera gillespieae* McPherson (*L. J. Gillespie, G. A. Levin, J. Andriantiana & W. M. Cardinal-McTeague 10657*, MO).

markedly swollen basally, pubescent to glabrous. Stipules broadly triangular, ca. 0.5 mm, caducous. Inflorescences axillary, bisexual typically, with 1 terminal and 0 to several subterminal pistillate flowers, unbranched, 2–14 cm, rachis 1–1.5 mm diam., densely pubescent; bracts 1.5–5 mm, bracteoles 0.5–3.5 mm, both appressed-pubescent abaxially. Staminate flowers lateral, pedicels 5–8 mm,

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HERBARIUM GENAVENSE, G
Plantes de la région de Daraina
Euphorbiaceae
Droceloncia rigidifolia (Baill.) J. Léonard
MADAGASCAR, province de Diego-Suarez /Antsiranana, sous-préfecture de Vohemar, commune rurale de Daraina.
Daraina, forêt d'Ambilondomba (13°10'S - 49°39'E)
A 930 m du point côté 544, au 112°, alt. 230 m.
Coord. précises (WGS 84): 13°9.87'S - 49°38.87'E
forêt dense semi décidue, dalles rocheuses en bordure de ruisseau
arbuste, 3 m, 25 cm DBH; fl mâle blanc-crème, 3 T en cuillère, réfléchi, E nombreuses, en bas de l'inflo. fl. femelle en haut de l'inflo T verts non réfléchis, à 3 styles, fr. tricoque velu, .
Pente: 25°; orientation: 220°; bas-fond. Echantillon séché à l'air chaud
18-12-2004
L. Nusbaumer & P. Ranirison, LN 1356
Duplicatum ex Conservatorio
Botanico Genavensi

Figure 3. Holotype specimen of *Argomuellera integra* McPherson (*L. Nusbaumer & P. Ranirison 1356*, MO).

pubescent, calyx splitting into 3 sepals, 4–5 mm, apically acute, stamens ca. 40, ca. 5 mm, glabrous; globose central disk 2–2.5 mm diam., pubescent. Pistillate flowers terminal, 0 to several additional lateral pistillate flowers also sometimes present below the terminal one, sessile or nearly so, sepals 4 to 6, 2.5–4 mm, pubescent abaxially, apically acute; disk obscure, apparently annular; ovary 3-lobed, ca. 1.5 mm high, densely long-pubescent; stylodia 3, erect-spreading, ca. 3.5 mm, fused basally ca. 1 mm,

pubescent. Fruits (not completely mature) 3-lobed, ca. 6 mm high, 1 cm diam., pubescent; seeds unknown.

Habitat, distribution, and phenology. *Argomuellera integra* grows in northern dry forests, at least sometimes on limestone, from near sea level to 600 m elevation. It has been collected in flower in September, November, and December, and in immature fruit in December.

Discussion. *Argomuellera integra* most resembles *A. stenophylla* McPherson in its relatively small, entire-margined leaves but can be distinguished by its wider leaves (1–3.5 vs. 0.5–2 cm in *A. stenophylla*) and more northerly (vs. southwestern) distribution.

Paratypes. MADAGASCAR. **Antsiranana:** Ambilobe, Mahamasina, Réserve Spéciale d'Ankarana, 12°55′10″S, 49°08′12″E, 125 m, s.d., *Bardot-Vaucoulon 909* (K not seen, MO, P not seen, TAN not seen); Daraina, forêt d'Bekaraoka, 13°06′S, 49°43′E, 127 m, s.d., *Nusbaumer & Ranirison 2197* (G); Daraina, forêt d'Ampondrabe, 12°58′S, 49°42′E, 429 m, s.d., *Nusbaumer & Ranirison 2199* (G); Massif de la Montagne d'Ambre, bassin de la Rivière des Makis, 600 m, s.d., *Service Forestier (Capuron) 11303* (P). **Mahajanga:** RN 8, Namoroka, s.d., *Morat 876* (MO, P not seen, TAN not seen).

4. Argomuellera longistipula McPherson, sp. nov. TYPE: Madagascar. Antsiranana: Sava, S of Fanambana, forêt d'Analalava-Antsoha, forested hills E of RN 5a, 13°35′55.7″S, 49°59′56.3″E, 88 m, 26 Oct. 2012, *L. J. Gillespie, G. A. Levin, J. Andriatiana & W. M. Cardinal-McTeague 10667* (holotype, MO-6719487!; isotypes, CAN not seen, P not seen, TAN not seen). Figure 4.

Diagnosis. *Argomuellera longistipula* McPherson is distinguished from its congeners in Madagascar and the Comoros by its long stipules (2–5[–7] mm vs. less than 2.5 mm in all other Madagascan species), as well as by its combination of persistently pubescent leaves, short (2–7 cm) and villous inflorescences, and its long sepals in the pistillate flowers (5–6 mm in flower, up to 20 mm in fruit).

Shrubs 1–4 m tall. Leafy portions of stem densely erect-pubescent, 2.5–4 mm diam.; leaves typically clustered near branch tips. Leaf blades oblanceolate to narrowly oblanceolate, 10–24 × 1.6–6.3 cm, base narrowly obtuse to attenuate, apex acuminate, margins shallowly dentate or subentire, both surfaces persistently pubescent, hairs most obvious along the venation, embedded glands scattered but usually visible on the abaxial surface, midrib not or barely raised adaxially, prominent abaxially, secondary veins 21 to 27 on each side of the midrib, evident. Petioles 3–8 mm, ca. 1.5 mm diam., pubescent. Stipules ensiform to occasionally narrowly triangular, 2–5(–7) mm, pubescent, subpersistent. Inflorescences axillary, bisexual typically, with 1 terminal and 0 to 3 subterminal pistillate flowers, unbranched, 2–7 cm, rachis 1–1.5 mm diam., densely erect-pubescent, hairs > 0.5 mm. Bracts 3–5 mm, bracteoles 2–4 mm, both densely pubescent. Staminate flowers lateral, pedicels 3–4 mm, erect-pubescent; calyx splitting into 2 to 3 sepals, ca. 2.5 × 1.5–2 mm, erect-pubescent abaxially, apically acute; stamens ca. 30, ca. 3 mm, glabrous; globose central disk ca. 2 mm diam., pubescent. Pistillate flowers terminal, solitary or with 0 to 3 subterminal others, subsessile; sepals 5, 5–6 × 5–6 mm in flower, soon accrescent and up to 20 mm in fruit, densely pubescent on both surfaces, apex acute; disk annular, pubescent; ovary 3-lobed, ca. 3 mm high, densely pubescent, fused portion of the 3 stylodia 2.5–3 mm, 3 recurved branches 4–6 mm, pubescent abaxially. Fruit unknown.

Habitat, distribution, and phenology. *Argomuellera longistipula* is known only from forests in a small area south of Vohémar, at elevations of 60–250 m. It has been collected in flower in July, October, and November.

Discussion. *Argomuellera longistipula* most resembles *A. oblanceolata* McPherson, but is easily separated from that and the other species of the genus by its long stipules, its long, dense indument of the inflorescence, its long sepals of the pistillate flowers, and its narrow distribution.

Paratypes. MADAGASCAR. **Antsiranana:** Sava, S of Fanambana, forêt d'Analalava-Antsoha, along path to radio tower, 13°35′30.9″S, 49°59′22.8″E, 110 m, s.d., *Gillespie, Levin, Andriatiana & Cardinal-McTeague 10661* (CAN not seen, MO, P not seen, TAN not seen); Vohémar, Fanambana, forêt d'Analalava-Antsoha, 13°35′44″S, 50°00′04″E, 61 m, s.d., *Rabenantoandro 499* (MO, P not seen, TAN not seen); Vohémar, Andrahanantsoa-Analava, PK 35 from Vohémar, 13°35′47.5″S, 49°35′12″E, 250 m, s.d., *Rakotonasolo 250* (K not seen, MO, P not seen, TAN not seen); Vohémar, Vohimarina, Fanambana, Antsatoby, 13°39′25″S, 50°01′04″E, 106 m, s.d., *Rasoafaranaivo 233* (MO, P not seen, TAN not seen).

5. Argomuellera oblanceolata McPherson, sp. nov. TYPE: Madagascar. Atsimo-Andrefana: Toliara, Analavelona, 800–1348 m, 10 Dec. 1955, *Service Forestier 15574* (holotype, P [barcode] P00502635!). Figure 5.

Diagnosis. *Argomuellera oblanceolata* McPherson can be distinguished from its congeners by its combination of relatively small, oblanceolate leaves (5.5–17.5 × 1.3–4.4 cm) with evident secondary venation and usually dentate margins, and short inflorescences (to 8 cm long), each bearing a solitary terminal pistillate flower.

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Plants of Madagascar
Pycnocoma
Euphorbiaceae
Antsiranana: Sava. Fiv. Vohemar. S of Fanambana, Forêt d'Analalava-Antsoha. Forested hills E of RN 5a. 13°35'55.7"S, 49°59'56.3"E. Accuracy: ±30m. Datum: WGS84. Elev.: 88m.
Disturbed humid forest.
Slender shrub 2 m, little-branched; inflorescences bisexual.
26 October 2012
L.J. Gillespie, G.A. Levin, J. Andriatiana, W.M. Cardinal-McTeague 10667
Det.: G. McPherson, G.A. Levin & L.J. Gillespie, 16 July 2013
TYPE SPECIMEN
Missouri Botanical Garden (MO)
National Herbarium of Canada, Canadian Museum of Nature
Fieldwork facilitated by the Missouri Botanical Garden Madagascar Research and Conservation Program and Parc Botanique et Zoologique de Tsimbazaza

Figure 4. Holotype specimen of *Argomuellera longistipula* McPherson (*L. J. Gillespie, G. A. Levin, J. Andriatiana & W. M. Cardinal-McTeague 10667*, MO).

Shrubs or small trees 1–8 m tall. Leafy portions of stem pubescent at first but typically soon glabrescent, 2–3 mm diam.; leaves often somewhat clustered near branch tips. Leaf blades oblanceolate to occasionally lanceolate, 5.5–20 × 1.3–5.5 cm, base cuneate or attenuate into the petiole, apex acute, usually acuminate, margins usually at least shallowly dentate in distal 1/2, teeth 3 to 10 on each side, or

occasionally subentire, abaxial surface appressed-pubescent while immature but glabrescent, with a sparse indument sometimes persisting on the midrib, embedded glands visible on the abaxial surface, midrib and secondary veins raised on both surfaces, secondaries 10 to 20 on each side of the midrib, evident on both surfaces. Petioles up to ca. 4 mm, glabrescent, often consisting mostly of a pulvinus-like basal portion ca. 2 mm diam. Stipules triangular, 0.5–1 mm, usually not persistent. Inflorescences axillary, bisexual typically, with a single terminal pistillate flower, unbranched, 1.5–8 cm, rachis ca. 1 mm diam., pubescent (the hairs ca. 0.3 mm); bracts and bracteoles 1–2.5 mm. Staminate flowers lateral, pedicels 2–4 mm, pubescent; calyx splitting into 2 to 4 sepals, 3–3.5 mm, pubescent abaxially, apically acute; stamens ca. 35, 3–5 mm, glabrous; globose central disk 1.5–2 mm diam., pubescent. Pistillate flowers terminal, solitary; pedicels 1–4 mm, pubescent; sepals 5 to 6, 1.5–4 mm, pubescent abaxially, apically acute; disk apparently annular, somewhat obscure, sparsely pubescent; ovary 3-lobed, 1.5 mm high, densely long-pubescent; stylodia 3, spreading, 2–4 mm, fused basally 1–2 mm, pubescent. Fruit 3-lobed, ca. 5–6 mm high, 1.2 cm diam., densely pubescent with both short and long hairs, the latter erect and ca. 1 mm; columella ca. 3.5 mm; seeds 3, ca. 5 mm diam.

Habitat, distribution, and phenology. *Argomuellera oblanceolata* has been collected in forests of western and southwestern Madagascar at elevations of 200–1350 m. It is noted as growing on limestone and basalt and is known in flower and in fruit in November and December.

Discussion. *Argomuellera oblanceolata* is similar to *A. longistipula* and *A. bilocularis* in having relatively small, dentate leaves and a short inflorescence, but is easily distinguished from the former by its short stipules and smaller pistillate sepals, and from the latter by its 3-locular ovary. As well, the three species do not appear to overlap geographically. Specimens with subentire leaves might be confused with *A. stenophylla* and *A. integra*, but its relatively wide, acuminately tipped leaves and, to some extent, its distribution set *A. oblanceolata* apart from these two species.

Paratypes. MADAGASCAR. **Mahajanga:** Melaky Region, Kimanambolo, Belitsaka, 18°02′09″S, 44°19′28″E, s.d., *Rakotonasolo 1391* (MO, P not seen, TAN not seen); Melaky Region, Maintirano, Belitsaky, Antsakoabe, Forêt d'Amboloando, 18°05′19″S, 44°32′08″E, 206 m, s.d., *Rakotovao 6153* (MO, TAN not seen). **Tuléar:** Sakaraha, Mahaboboka, Marotsiraka-Betsileo, Andranohe-za, 22°40′41″S, 44°11′30″E, 1091 m, s.d., *Andriamihajarivo 1457* (MO, P not seen, TAN not seen), *1461* (MO, P not seen, TAN not seen); 22°38′33″S, 44°10′12″E, 1286 m, s.d., *Andriamihajarivo 1478* (MO, P not seen, TAN not seen); Forêt d'Analavelona, Bassin du Fiherenana, 1000–1200 m, s.d., *Humbert 19782* (MO, P not seen); Forêt d'Analavelona, près d'Antanimena, 12.5 km NW d'Andranoheza, 22°40′42″S, 44°11′30″E, 1050 m, s.d., *Messmer 590* (G not seen, MO, TAN not seen); Forêt d'Analavelona, 11.5 km NO d'Andranoheza, 1000–1348 m, s.d., *Randriatafika 222* (MO, P not seen, TAN not seen).

6. Argomuellera stenophylla McPherson, sp. nov. TYPE: Madagascar. Atsimo-Andrefana (SE): Toliara, Zombitsy Natl. Park, along Sentier LOBO, 22°53′20.6″S, 44°42′00.1″E, 760 m, 1 Dec. 2012, *L. J. Gillespie, G. A. Levin & J. Razanatsoa 10833* (holotype, MO-6712928!; isotypes, CAN not seen, P not seen, TAN not seen). Figure 6.

Diagnosis. *Argomuellera stenophylla* McPherson is easily recognized within the genus by its combination of short, narrow leaves, 5–13 × 0.5–1.7(–2) cm, with thickened, entire margins and obscure abaxial venation, and its short inflorescences, 2–8.5 cm, each bearing a solitary terminal pistillate flower.

Shrubs or small trees 1–4 m tall. Leafy portions of stem appressed-pubescent at first but typically soon glabrescent, ca. 2 mm diam.; leaves typically clustered near branch tips. Leaf blades narrowly elliptic to oblong to narrowly oblanceolate, 5–13 × 0.5–1.7(–2) cm (damaged leaves occasionally slightly wider), base attenuate, apex acute to obtuse, typically mucronulate, margins entire, thickened, abaxial surface appressed-pubescent while immature but usually glabrescent, embedded glands visible on the abaxial surface midrib raised on both surfaces, the secondary veins ca. 14 to 18 on each side of the midrib, obscure on both surfaces. Petioles swollen, pulvinus-like, 1–2 mm, ca. 1.5 mm diam., pubescent, glabrescent. Stipules minute, triangular, up to 0.5 mm, usually not persistent. Inflorescences axillary, bisexual typically, with a single terminal pistillate flower, unbranched, 2–8.5 cm, the rachis up to 1 mm diam., pubescent with subappressed hairs. Bracts and bracteoles 1–2 mm. Staminate flowers lateral, pedicels 3–5 mm, pubescent; calyx splitting into 3 sepals, 2–3 × 1.5–2 mm, pubescent abaxially, apically acute; stamens ca. 30 to 35, 4 mm, glabrous; globose central disk ca. 1.5 mm diam., densely pubescent. Pistillate flowers terminal, solitary, pedicels 1–1.5 mm, pubescent; sepals (4 to)5(to 6) in number, 3–4 × 1–2 mm, pubescent abaxially, apex acute; disk annular, sometimes obscure, ciliate; ovary 3-lobed, 2 mm high, erect-pubescent, fused portion of the 3 stylodia

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Echantillon : Fl
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Lieu de récolte : Analavelona-Tuléar
Date de récolte : 10 - 12 - 55
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Figure 5. Holotype specimen of *Argomuellera oblanceolata* McPherson (*Service Forestier 15574*, P).

1 mm, 3 recurved branches ca. 1.5 mm. Fruit (not completely mature) 3-lobed, ca. 7 mm high, 1.3 cm diam., densely pubescent with both short and long hairs, the latter erect and ca. 0.7 mm; seeds unknown.

Habitat, distribution, and phenology. *Argomuellera stenophylla* grows in deciduous forests of southwestern Madagascar at elevations of 280–800 m. It has been collected in bud or flower from November to April.

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Plants of Madagascar
Pycnocoma
Euphorbiaceae
Toliara: Atsimo-Andrefana (South-East). Zombitse National Park, along Sentier LOBO. 22°53'20.6"S, 44°42'0.1"E. Datum: WGS84. Elev.: 760m.
Disturbed decidous forest, uneven canopy 10-15 m, with emergent trees; pale brown sand.
Slender shrub 2m; branches ascending; inflorescences erect, bisexual with numerous staminate flowers and a single terminal pistillate flower; capsules green, styles pale yellow, persistant.
1 December 2012
L.J. Gillespie, G.A. Levin, J. Razanatsoa 10833
Det.: G. McPherson, G.A. Levin & L.J. Gillespie, 16 July 2013
Photographs
National Herbarium of Canada, Canadian Museum of Nature
Fieldwork facilitated by the Missouri Botanical Garden Madagascar Research and Conservation Program and Parc Botanique et Zoologique de Tsimbazaza

Figure 6. Holotype specimen of *Argomuellera stenophylla* McPherson (*L. J. Gillespie, G. A. Levin & J. Razanatsoa 10833*, MO).

Discussion. *Argomuellera stenophylla* bears flowers that closely resemble those of *A. oblanceolata*, described above, which furthermore has a partially overlapping distribution. However, the two species differ consistently in the leaf characteristics given in the key (margins entire, apex obtuse or acute but not acuminate, blade narrowly elliptic to oblanceolate in *A. stenophylla* vs. margins dentate at least distally, apex usually somewhat acuminate, blade oblanceolate in *A. oblanceolata*).

Paratypes. MADAGASCAR. **Tuléar:** Sakaraha, s.d., *Bosser 9144* (MO); Forêt d'Analamarima, valleé de l'Hazoroa, au S de Sakaraha, s.d., *Humbert 19631* (G, MO, P), *19639* (P); Forêt du Zombitsy avant Sakaraha, s.d., *Keraudren 459* (MO), *505* (P); Rte. Nationale no. 7 at 30 km NE of Sakaraha, s.d., *Lorence 2085* (MO); Sakaraha, Forêt de Zombitsy, RN 7, PK 783, 22°53′S, 44°38′E, s.d., *Randrianaivo 190* (MO, TAN not seen); Atsimo-Andrefana Region, Beroroha, fokontany Betorabato, forêt Akolitsika, 21°40′22″S, 44°5′36″E, s.d., *Razakamalala 6117* (MO, TAN not seen).

Note on *Argomuellera decaryana* (Leandri) J. Léonard

In distinguishing *Pycnocoma decaryana* Leandri from *P. perrieri* Leandri, Leandri (1941) relied on differences in leaf length (ca. 75 cm in *P. decaryana* vs. 50 cm in *P. perrieri*), leaf margin (strongly dentate vs. subentire), and pistillate sepal length (accrescent to 5–6 mm vs. 2 mm). Now that collections in addition to the two type gatherings are available for study, it is apparent that no correlations exist among these characters, although the sepals of *Decary 99* (the type of *P. decaryana*) remain the longest ones known within the species s.l. The two names were published simultaneously, but Perrier's collection is more complete and better resembles material collected subsequently, and therefore *P. decaryana* and its combination in *Argomuellera* are here relegated to the synonymy of *A. perrieri* (Leandri) J. Léonard. The type collections of each of these two taxa are represented at P by two duplicates between which Leandri made no selection. These duplicates are, therefore, syntypes of their respective names and lectotypification is appropriate.

Argomuellera perrieri (Leandri) J. Léonard, Bull. Soc. Roy. Bot. Belgique 91: 276. 1959. Basionym: *Pycnocoma perrieri* Leandri, Notul. Syst. (Paris) 9: 167. 1941. TYPE: Madagascar. Forêt orientale, sur la rivière Fandrarazana (côte E), vers 200 m d'altitude, Sep. 1912, *Perrier de la Bâthie 9708* (lectotype, designated here, P [barcode] P00072296!; isolectotype, P [bc] P00072297!).

Argomuellera decaryana (Leandri) J. Léonard, Bull. Soc. Roy. Bot. Belgique 91: 275. 1959, syn. nov. Basionym: *Pycnocoma decaryana* Leandri, Notul. Syst. (Paris) 9: 167. 1941. TYPE: Madagascar. Isalo, Ranolahira, 15 Sep. 1920, *Decary 99* (lectotype, designated here, P [barcode] P00554256!; isolectotype, P [bc] P00554257!).

Key to *Argomuellera* Species in Madagascar and the Comoro Islands

1. Ovary 2-parted; leafy portions of stem 3.5–6 mm diam.; inflorescences 3–4 cm long; pistillate flowers solitary and terminal in each inflorescence ..... *A. bilocularis* McPherson
1′. Ovary 3-parted; stem diameter, inflorescence length, and pistillate flower characteristics various, but not in the above combination 2
2. Inflorescence branched, the rachis 3–4 mm diam. ..... *A. perrieri* (Leandri) J. Léonard
2′. Inflorescence unbranched or rarely with a few short basal branches, but then the rachis less than 2 mm diam. (*A. pumila* McPherson) 3
3. Stipules 2–5(–7) mm long, subpersistent; Vohémar Region of Madagascar ... *A. longistipula* McPherson
3′. Stipules < 2 mm long, soon falling; variously distributed 4
4. Leaf blades, at least the larger ones, > 6 cm wide 5
5. Leaf pubescence dense; flowers clustered, inflorescence rachis not visible ..... *A. calcicola* (Leandri) J. Léonard
5′. Leaf pubescence sparse to absent; flowers separated, inflorescence rachis visible 6
6. Inflorescence rachis densely pubescent; sepals of pistillate flowers > 4 mm long 7
7. Leaf blades, at least the longer ones, > 40 cm; Madagascar ..... *A. gigantea* (Baill.) Pax & K. Hoffm.
7′. Leaf blades up to ca. 35 cm long; Comoro Islands ..... *A. trewioides* (Baill.) Pax & K. Hoffm.
6′. Inflorescence rachis sparsely puberulent; sepals of pistillate flowers < 3 mm long ..... *A. gillespieae* McPherson
4′. Leaf blades up to 6 cm wide 8
8. Longer petioles > 1.5 cm long; leaf blades, at least the longer ones, > 25 cm long; inflorescences > 20 cm long 9
9. Petioles < 3 cm long; bracts 2.5–3 mm long; inflorescence rachis 2 mm diam.; stamens 35 to 40; eastern forest of Madagascar ..... *A. danguyana* (Leandri) J. Léonard
9′. Petioles, at least the longer ones, > 3 cm long; bracts up to 1 mm long; inflorescence rachis 1 mm diam.; stamens 14 to 28; southeastern littoral forest of Madagascar ..... *A. pumila* McPherson
8′. Longer petioles < 1 cm long; leaf blades < 25 cm long; inflorescences < 15 cm long 10
10. Leaf margins dentate at least distally, apex usually somewhat acuminate, blade oblanceolate ..... *A. oblanceolata* McPherson

10′. Leaf margins entire, apex obtuse or acute but not acuminate, blade narrowly elliptic to oblanceolate 11
11. Leaf blades 5–17(–20) mm wide, narrowly elliptic, oblong, or narrowly oblanceolate, secondary veins rather obscure abaxially; inflorescences with 1 terminal pistillate flower; southwestern Madagascar ..... *A. stenophylla* McPherson
11′. Leaf blades, at least the wider ones, > 20 mm wide, elliptic, obovate, or oblanceolate, secondary veins easily seen abaxially; inflorescences often with 2 or more distal pistillate flowers; northern Madagascar ..... *A. integra* McPherson

Acknowledgments. I wish to thank the curators of CAN, G, and P for their specimen loans. Louis Nusbaumer and Martin Callmander of G very kindly went to some lengths ferreting out relevant material, and Mike Blomberg (MO) created the scans used as illustrations.

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Youngia jiulongensis (Crepidinae, Cichorieae, Asteraceae), a New Species from Sichuan, China

Yu-Lan Peng and Xin-Fen Gao

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Li-Bing Zhang

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ABSTRACT. *Youngia jiulongensis* Y. L. Peng, X. F. Gao & Li Bing Zhang, a new species of Asteraceae from western Sichuan, China, is described. This new species is similar to *Y. mairei* (H. Lév.) Babc. & Stebbins and *Y. pilifera* C. Shih in having blackish brown achenes, a white pappus, and fewer capitula, but distinct from the latter two in having a taller stature (28–50 cm vs. 8–30 cm), two or three well-developed, undivided caudical leaves, sparsely toothed leaf margins, acute leaf apices, long non-winged petioles, reduced pubescence on the whole plant, glabrous phyllaries, and midveins of all inner phyllaries plane.

Key words: Asteraceae, China, *Youngia*.

Youngia Cass. is a genus of ca. 30 species in Asia, 28 of which occur in China (22 endemic; Shih & Kilian, 2011). The highest diversity of this genus is undoubtedly found in the Hengduan Mountains of China. Most species of *Youngia* have narrow distributions; of an apparently natural group of 13 species sometimes called "*Youngia* sect. *Mesomeris* Babc. & Stebbins" (though that name is not validly published), 10 are only found in the Hengduan Mountains. Phylogenetic analysis based on nuclear ITS data resolved the genus as sister to *Crepidiastrum* Nakai with only weak support (Kilian et al., 2009). Reliable megafossil records of the genus are lacking (Manchester et al., 2015). Since this genus was established by H. Cassini in 1831, more and more species have been discovered and described (Babcock, 1928; Babcock & Stebbins, 1937; Shih, 1995; Deng et al., 2014). Here we add one more species to the genus from western Sichuan, China: *Y. jiulongensis* Y. L. Peng, X. F. Gao & Li Bing Zhang, which is possibly closely related to the "*Youngia* sect. *Mesomeris*" group. We were unable to extract DNA of *Y. jiulongensis* from the type specimens. *Youngia jiulongensis* shows some intermediate morphological characters between "*Youngia* sect. *Youngia*" and "*Youngia* sect. *Mesomeris*," and thus its systematic position cannot be determined based on morphological evidence alone.

Youngia jiulongensis Y. L. Peng, X. F. Gao & Li Bing Zhang, sp. nov. TYPE: China. Sichuan: Jiulong Co., Naiqu, sloping fields, 2400 m, 11 Aug. 1979, *Q. Q. Wang 21519* (holotype, CDBI-10148861!; isotype, CDBI-10148862!). Figure 1.

Diagnosis. *Youngia jiulongensis* Y. L. Peng, X. F. Gao & Li Bing Zhang is similar to *Y. pilifera* C. Shih and *Y. mairei* (H. Lév.) Babc. & Stebbins, but is distinguished from the former by its undivided caudical leaves, from the latter by its acute (not acuminate) leaf apices, and from both by its taller stature (28–50 cm vs. 8–30 cm), reduced pubescence on the whole plant, 2 or 3 well-developed caudical leaves with sparsely toothed leaf margins, and long non-winged petioles.

Herbs, usually 28–50 cm tall. Taproot with shoot-bearing lateral roots. Stem solitary, slender, erect, sparsely branched from middle, apically glabrous, basally often pubescent, distantly leafy or almost leafless, 2 or 3 lower stem leaves with petiole 4–7.5 cm, blade undivided, lanceolate or ovate, with a few short appressed hairs on both sides, 4–6 × 2–3 cm, papery, base truncate, apex acute, with blade margins coarsely dentate (teeth 0.05–0.08 mm). Uppermost stem leaves 1 or 2, reduced, undivided, linear-subulate and bractlike. Synflorescences paniculately few-branched, lower branches paniculately few-headed, upper branches short, cymose corymbiform, peduncles usually 0.5–3 cm, slender, glabrous, erect, 1-bracteate. Capitula 13 to 15, with 8 to 10 yellow florets. Involucre cylindric; outer phyllaries 5, dark green, margins white membranous, ovate, 1.5 mm, apex acute, both surfaces glabrous; inner phyllaries

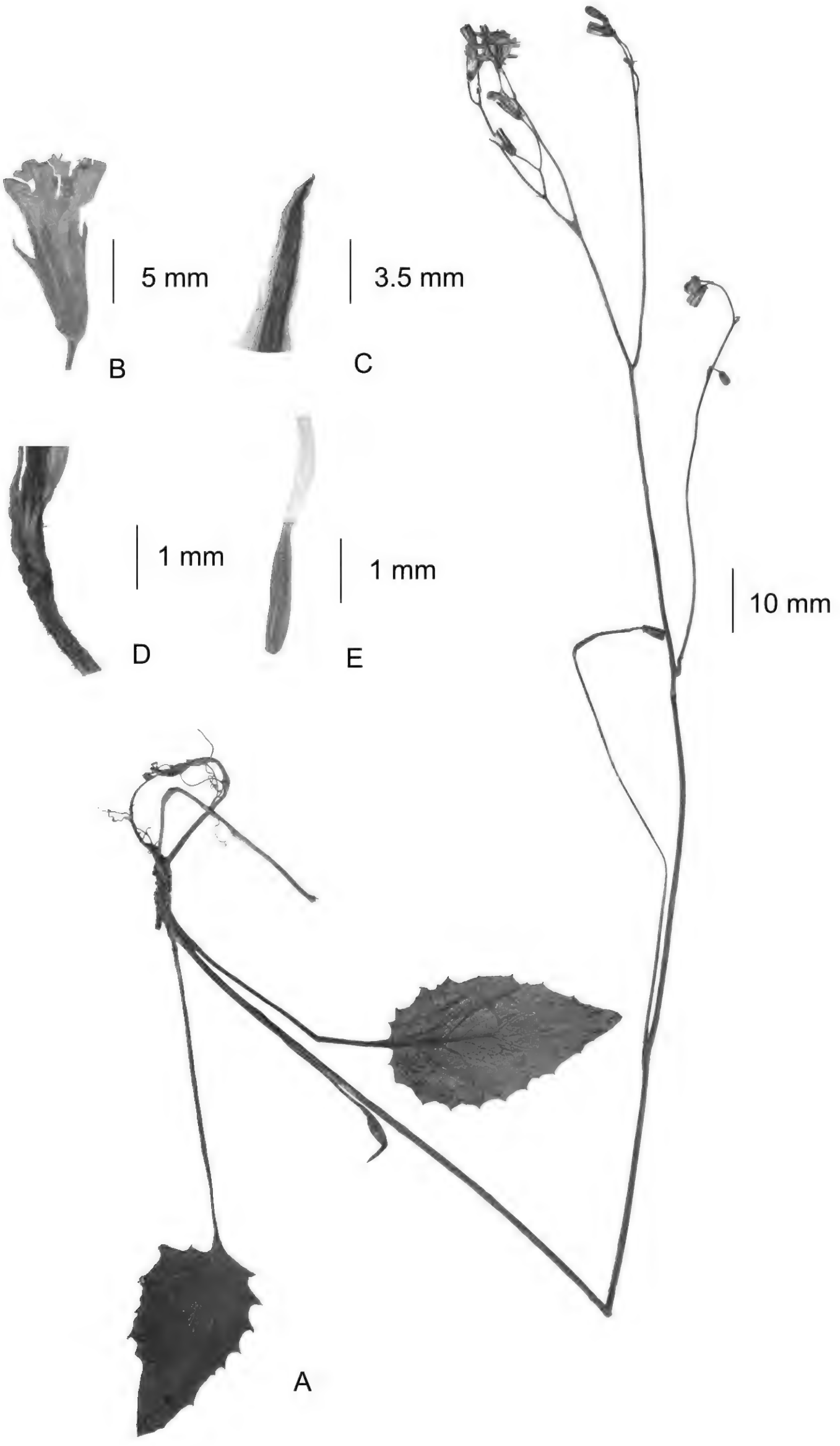

Figure 1. *Youngia jiulongensis* Y. L. Peng, X. F. Gao & Li Bing Zhang. —A. Habit. —B. Capitulum. —C. Inner phyllary. —D. Floret tube. —E. Achene and pappus. From the holotype *Q. Q. Wang 21519* (CDBI-10148861).

8, dark green, margins white membranous, lanceolate, 7–8 × 1.5 mm, midrib plane, apex acute, adaxial surface appressed pubescent. Florets with corolla 8 mm, ligule 1.5 mm, corolla tube externally pubescent, internally glabrous. Anther tube dark green. Style branches yellow upon drying. Achenes dark brown, flattened, ribs unequal, 2–3 mm; pappus white, 4–5 mm, 1-seriate, bristles fine, persistent.

Distribution and habitat. *Youngia jiulongensis* is only known from the type locality and was observed to grow on rocky slopes at an elevation of 2400 m.

IUCN Red List category. According to the field record in 1979 there were abundant individuals, but we failed to find any plants in the same locality in 2010. Based on the information known to us and the IUCN Red List criteria (IUCN, 2001), *Youngia jiulongensis* should be classified as Critically Endangered (CR B1ab(v)+B2ab(v)): it is known to exist at only a single location, the known area of occupancy is less than 10 km^2, the extent of occurrence is less than 100 km^2, and there is observed decline in the number of mature individuals.

Phenology. *Youngia jiulongensis* flowers and fruits in August.

Etymology. The epithet of the new species is taken from the name of the county, Jiulong, in western Sichuan, China, where the type was collected.

Taxonomic notes. There are only three species of *Youngia* found in Jiulong, according to our previous field survey and specimen records, including *Y. japonica* (L.) DC., *Y. pilifera*, and *Y. heterophylla* (Hemsl.) Babc. & Stebbins. Morphologically, *Y. jiulongensis* is similar to *Y. pilifera* in having relatively few flower heads and blackish brown achenes with a white pappus, but the latter has seven or eight densely strigose caudical leaves and at least some leaves lyrately pinnatipartite, with 1–1.5 cm winged petioles. The leaves of *Y. jiulongensis* are similar to those of some individuals of *Y. japonica* with undivided leaves, but *Y. jiulongensis* has thicker leaves and larger, blackish brown achenes, which distinguish it from *Y. japonica* or any species of "*Youngia* sect. *Youngia*."

Youngia jiulongensis resembles *Y. mairei*, which has not been reported from Jiulong County, but does occur in relatively close proximity, in having serrate-margined leaves and similarly shaped achenes and panicles, but the latter has six or seven caudical leaves, acuminate leaf apices, and winged petioles 0.5–2 cm. Species of "*Youngia* sect. *Mesomeris*," including *Y. mairei*, *Y. pilifera*, *Y. fusca* (Babc.) Babc. & Stebbins, *Y. kangdingensis* C. Shih, *Y. nujiangensis* C. Shih, and *Y. paleacea* (Diels) Babc. & Stebbins, are similar to one another in geographical distribution and morphology. Their delimitation sometimes is quite confusing and they have been treated differently by different authors (Babcock & Stebbins, 1937; Shih, 1995, 1997; Shih & Kilian, 2011). For example, *Y. nujiangensis* was treated as a synonym of *Y. lanata* Babc. & Stebbins in *Flora of China* (Shih & Kilian, 2011); the circumscriptions of *Y. kangdingensis*, *Y. mairei*, *Y. nujiangensis*, *Y. pilifera*, and *Y. paleacea* were also questioned by Shih and Kilian (2011). However, *Y. jiulongensis* is clearly distinguishable from all other described species in this group, which usually grow in small, moist, patchy habitats in dry valleys in the Hengduan Mountains. *Youngia terminalis* Babc. & Stebbins is a poorly known species in Kangding whose type specimens are destroyed, and its delimitation and systematic position are still problematic. Our nuclear ITS data suggest that *Y. terminalis* may be conspecific with *Y. pilifera* (Peng et al., unpublished data). Morphologically, *Y. terminalis* and *Y. pilifera* both have a basal rosette and the midveins of some inner phyllaries are subapically crested or corniculate, but *Y. jiulongensis* has neither a basal rosette nor inner phyllaries subapically crested or corniculate. *Youngia jiulongensis* resembles *Y. henryi* (Diels) Babc. & Stebbins, *Y. prattii* (Babc.) Babc. & Stebbins, and *Y. wilsonii* (Babc.) Babc. & Stebbins in its plane midvein of all inner phyllaries, but *Y. jiulongensis* is significantly different from the latter three species in having lower stem leaves undivided rather than pinnatifid to pinnatipartite or pinnatisect. The latter three grow in very wet habitats between 1500 and 2000 m at the edge of broad-leaved forests.

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A Contribution to *Teucrium* sect. *Polium* (Lamiaceae) in *Flora Iranica*

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Abstract. The taxonomic status of *Teucrium* L. sect. *Polium* (Mill). Schreb. in *Flora Iranica* is reviewed. A few taxonomic changes have become necessary in section *Polium* in view of the material investigated for a new edition of the Flora. Revision of extensive herbarium material and detailed studies of plants in the field revealed that five species of *Teucrium* sect. *Polium* occur in Iran. A new species of this section is reported from the dry-stone zone in a mountainous region in Fars Province of Iran. This new species is described and illustrated as *T. abolhayatensis* Ranjbar & Mahmoudi. *Teucrium gabrielae* Bornm., in recent treatments recognized as a subspecies or variety of *T. stocksianum* Boiss., is reinstated at species level. A key, annotated enumeration of species, and notes on the distribution of the species are also provided. In addition, some aspects of the nomenclature of *T. gnaphalodes* L'Hér. are discussed, and lectotypes are designated for *T. gabrielae* and *T. stocksianum*.

Key words: Iran, IUCN Red List, Lamiaceae, *Teucrium*, *Teucrium* sect. *Polium*.

Teucrium L. is one of the largest genera belonging to Lamiaceae, subfamily Ajugoideae (Harley et al., 2004). The genus is very large, polymorphic, and cosmopolitan, consisting of ca. 260 species and more than 370 taxa in total (Tutin & Wood, 1972; Govaerts et al., 2016). Approximately 250 species are distributed around the Mediterranean basin, which is the major center of diversity (Cantino et al., 1992; Navarro & El Oualidi, 2000; Govaerts et al., 2016). *Teucrium* is distinguished from the other members of Lamiaceae by its corolla lacking an upper lip and its non-gynobasic style (Rechinger, 1982; Navarro & El Oualidi, 2000; De Martino et al., 2010). In *Flora Iranica* the genus is represented by 15 species, of which 12 species occur in Iran proper and four are endemic (Rechinger, 1982). *Teucrium* has been divided into seven sections in the *Flora Iranica* (Rechinger, 1982). The division of *Teucrium* into sections has been largely based on inflorescence, calyx, and leaf morphology (Boissier, 1879). *Teucrium* sect. *Polium* (Mill). Schreb. is represented by five species in Iran (Rechinger, 1982; Navarro & El Oualidi, 2000).

The aim of the present investigation was to study the morphology and taxonomy of *Teucrium* sect. *Polium* species in Iran. A few taxonomic changes have become necessary in section *Polium* in view of the material investigated for a new edition of the *Flora Iranica*. In addition, good material was collected and observations made of living populations on a recent expedition. This allowed a better understanding of the section.

This article follows previous taxonomic studies conducted on other groups of Lamiaceae in Iran (Ranjbar & Pakatchi, 2014; Ranjbar et al., 2014, 2015; Ranjbar & Mahmoudi, 2015). The present treatment is based on collections kept in the BASU herbarium and on photos of type specimens at B, G, JE, LINN, and W. In addition, fresh material of most taxa has been studied and field observations have been conducted.

Teucrium L. sect. **Polium** (Mill). Schreb., Pl. Verticill. Unilab. Gen. Sp., 41. 1773. Basionym: *Polium* Mill., Gard. Dict. Abr., ed. 4. 1754. TYPE: *Teucrium polium* L., Sp. Pl. 2: 566. 1753.

Suffrutescent perennials with terete stems. Leaves entire or crenate, often revolute. Flowers very shortly pedicellate, borne in dense heads. Calyx tubular-campanulate, teeth subequal. Nutlets 2–3 mm (Boissier, 1879).

Teucrium sect. *Polium* is widespread, but a very large number of species are present in the Mediterranean. Most species are distributed in southern Europe, North Africa, and southwest Asia. They often grow in semi-arid and arid bioclimates and prefer sun and light, well-drained soil, growing on hillsides or sands and in arid places (Rechinger, 1982). The prevailing altitudes for this section are between 1000 and 3000 m. In Iran, the section has five species and is distributed from central to northern, northwestern and western, and southeastern Iran, in Alborz, Azerbaijan, Chahrmahal va Bakhtiari, Esfahan, Fars, Hamedan, Kerman, Kohgeloyeh va Boyer Ahmad, Kurdestan, Lorestan, Markazi, Mazandaran, Qazvin, Tehran, and Zanjan Provinces (Fig. 1). It seems that

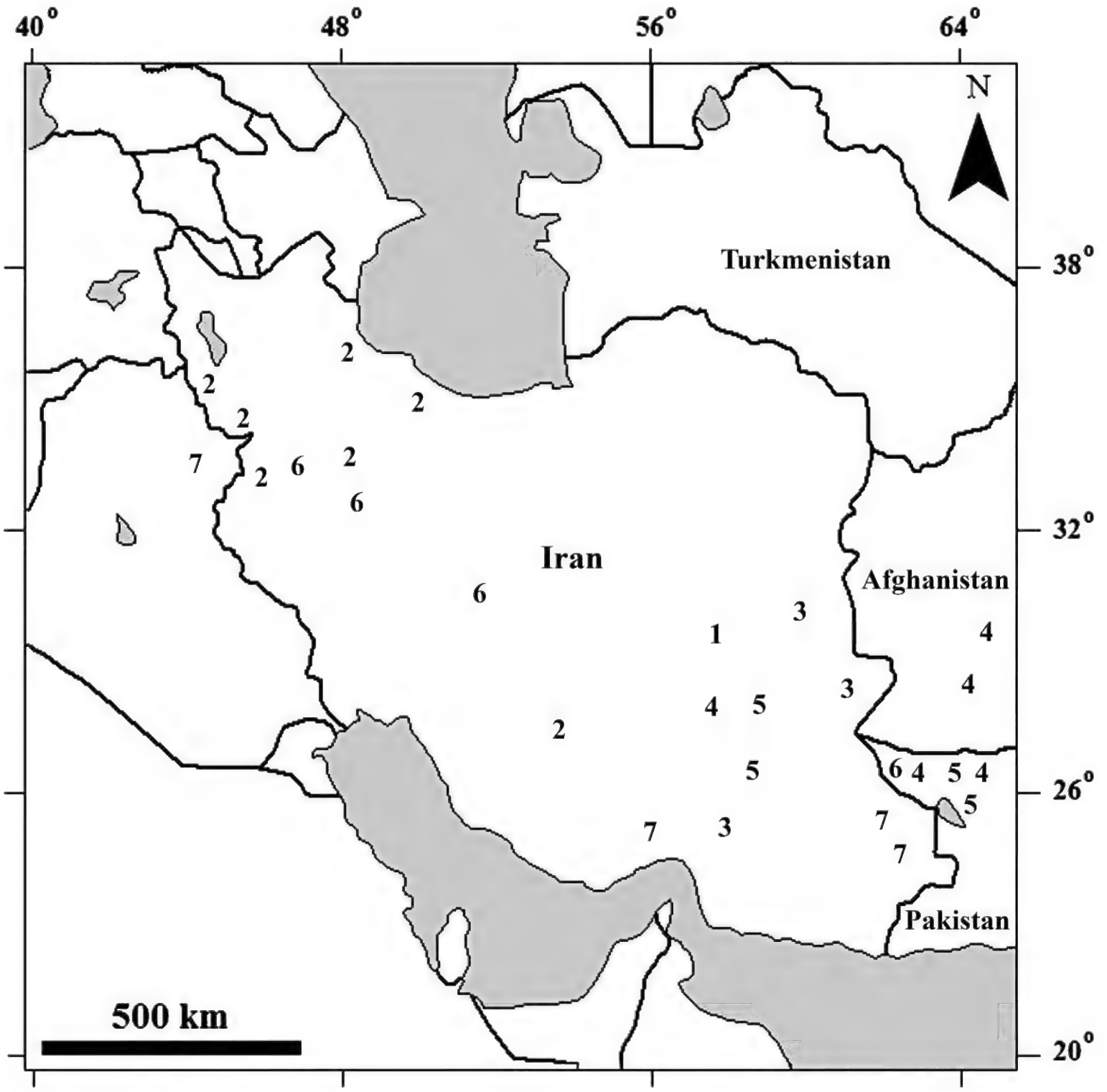

Figure 1. Distribution of *Teucrium* L. species in Iran and neighboring countries. —1. *Teucrium abolhayatensis* Ranjbar & Mahmoudi. —2. *Teucrium polium* L. —3. *Teucrium gabrielae* Bornm. —4. *Teucrium stocksianum* Boiss. subsp. *incanum* (Aitch. & Hemsl.) Rech. f. —5. *Teucrium stocksianum* Boiss. subsp. *patulum* (Hedge & Lamond) Rech. f. —6. *Teucrium stocksianum* Boiss. subsp. *stocksianum*. —7. *Teucrium gnaphalodes* L'Hér.

local endemism plays an important role in this section. Two species, the newly described *T. abolhayatensis* Ranjbar & Mahmoudi and *T. gabrielae* Bornm., are endemic to Iran.

Key to *Teucrium* sect. *Polium* Species in Iran

1a. Leaves entire ..... 2. *T. gabrielae* Bornm.
1b. Leaves dentate with few unequal teeth on each margin.
  2a. Leaves narrowly elliptic, oblong, or obovate; corolla basal lobes with hirsute posterior margin .... 5. *T. stocksianum* Boiss.
  2b. Leaves lanceolate, oblong-lanceolate, or oblong-linear; corolla basal lobes with ciliate or glabrous posterior margin.
    3a. Inflorescence 3–15 cm; corolla basal lobes distant to the lateral lobe, with glabrous posterior margin ..... 4. *T. polium* L.
    3b. Inflorescence 1–3 cm; corolla basal lobes appressed to the lateral lobe, with ciliate posterior margin.
      4a. Leaves 8–10 × 2–3 mm; inflorescence forming a flower head with (2 to)4 to 8(to 10) flowers; corolla cream, pink, or purple ..... 3. *T. gnaphalodes* L'Hér.
      4b. Leaves 12–20 × 3–7 mm; inflorescence forming a flower head with 10 to 17 flowers; corolla yellow ..... 1. *T. abolhayatensis* Ranjbar & Mahmoudi

1. Teucrium abolhayatensis Ranjbar & Mahmoudi, sp. nov. TYPE: Iran. Fars: Abolhayat Canyon, 95 km from Kazerun toward Shiraz, 1167 m, 28 Apr. 2011, *Ranjbar & Mahmoudi 24145* (holotype, BASU!). Figure 2.

Diagnosis. *Teucrium abolhayatensis* Ranjbar & Mahmoudi is similar to *T. polium* L. but differs from it by greater height 50–60 cm (vs. 20–45 cm), leaves 12–20 × 3–7 mm (vs. 10–12 × 2–3 mm), crenate-dentate with 4 to 5 acute teeth on each margin (vs. sinuate-undulate, with 2 to 4 obtuse teeth on each margin), inflorescence 1–3 cm (vs. 3–15 cm), flower head with 10 to 17 flowers (vs. 5 to 7 flowers), calyx 5–5.5 mm (vs. [2–]2.3–3.5[–4] mm), grayish and densely tomentose with long, woolly indument with simple trichomes (vs. green and pubescent or tomentose with intertwined branched trichomes, rarely with simple trichomes).

Perennial herbs, 50–60 cm tall, with suberect stems, usually simple or with short branches, ascending, indumentum pannose, of dense, long trichomes, with mixed appressed-stellate trichomes, whitish. Leaves subsessile or shortly petiolate, oblong or oblong-linear, acute, 12–20 × 3–7 mm when fully open, gray or whitish on both sides, margins slightly revolute, crenate-dentate, with 4 to 5 acute teeth on each margin, both surfaces pannose with hispidulous-villous trichomes and scattered glands. Inflorescence 1–3 cm, forming a flower head with 10 to 17 flowers, obpyramidal, flat-topped or rounded, by the end of the flowering period often slightly elongated and ovoid, terminal at apex of stem or branches. Bracts foliaceous, greenish, 5.2–8.2 × 1–2 mm, linear, narrowly oblong, with revolute margins, entire except for an apical tooth. Flowers sessile or shortly petiolate. Calyx tubular, 5–5.5 mm; tube curved, 3.8–4.5 × 1.8–2 mm, 5-nerved, reticulately veined, grayish, woolly-tomentose, densely covered with long (3.2–3.5 mm), simple trichomes; teeth equal, ovate-oblong with apex obtuse, 1.2–1.5 × 0.6–0.8 mm. Corolla yellow; tube 2.7–5.6 × 11–1.5 mm, slightly curved, externally subglabrous toward the base and pubescent at the region of the throat, internally glabrous toward the base and pubescent at the region of the throat; limb 4–5.5 mm; basal lobes appressed to the lateral lobe, oblong-lanceolate, 1.3–2 × 0.6–0.8 mm, with glandular trichomes, yellowish, with ciliate posterior margin and glandular trichomes in the anterior margin, lateral lobes appressed to the median lobe, oblong, 1.3–1.5 × 0.6–0.7 mm, median lobe nearly circular, 1.6–2.2 × 1.3–2.2 mm, cucullate; external surface of all lobes thinly pubescent and with sessile glands, internal surface gland-dotted, glabrous at the lateral and median lobe margins. Filaments thinly pilose, adaxial 1.4–3.9 mm, abaxial 2.7–5.5 mm; anthers pinkish, 0.6–1.2 mm. Ovary glabrous, ca. 0.6–0.8 mm; style thinly pubescent, 4.5–6 mm; stigmatic lobes subulate, unequal, 0.5–0.8 mm. Nutlets blackish, somewhat obovate, 1.2–1.5 × 0.6–1 mm, granulose, slightly reticulately veined, apex rounded, base wedge-shaped, attachment area flat, suborbicular, 0.6–0.7 mm diam., adjacent area convex.

Phenology. *Teucrium abolhayatensis* flowers between early April and late July.

Distribution and ecology. *Teucrium abolhayatensis* is endemic to southern Iran and grows on a rocky mountainside, on soil with a high percentage of clay around Abolhayat Canyon in Fars Province. It grows along with *Scutellaria farsistanica* Rech. f., *Phlomis olivieri* Benth., *P. pachyphylla* Rech. f., and *Echinops ceratophorus* Boiss., at elevations of 1000–1200 m.

Etymology. The specific epithet refers to Abolhayat in Fars Province, where the new species is found.

IUCN Red List category. *Teucrium abolhayatensis* is known from a few small populations, consisting of no more than 15 plants, observed in Abolhayat Canyon (M. Ranjbar, pers. obs.). According to the IUCN Red List criteria (IUCN, 2001), this species could be classified as Critically Endangered (CR D). This category includes taxa for which fewer than 50 mature individuals exist.

Discussion. *Teucrium abolhayatensis* is probably closely related to *T. polium* because of the resemblance in habit and inflorescence shape. However, *T. abolhayatensis* differs from *T. polium* in characters including stem indument, leaf size and shape, calyx indument, and corolla shape (Fig. 3; Table 1).

2. Teucrium gabrielae Bornm., Beih. Bot. Centralbl. 49-B: 311. 1939. *Teucrium stocksianum* Boiss. subsp. *gabrielae* (Bornm.) Rech. f., Fl. Iranica 150: 30. 1982. *Teucrium stocksianum* Boiss. var. *gabrielae* (Bornm.) Jamzad, Fl. Iran 76: 82. 2012. TYPE: Iran. Sistan va Beluchistan, Taftan, in valle Sanjanak, 1500 m, *Gabriel 108* (lectotype, designated here, B [B100277646] image!; isolectotype, W image!).

Perennial herbs, 10–25 cm tall, robust, branched from the base with numerous erect, ascending branches, very densely covered with long, white to gray indument, intermixed with spreading, long or short, glandular ones. Leaves sessile or subsessile, lanceolate, 6–8 × 3–4 mm, grayish, base subacute, apex acute, margins entire, both surfaces tomentose,

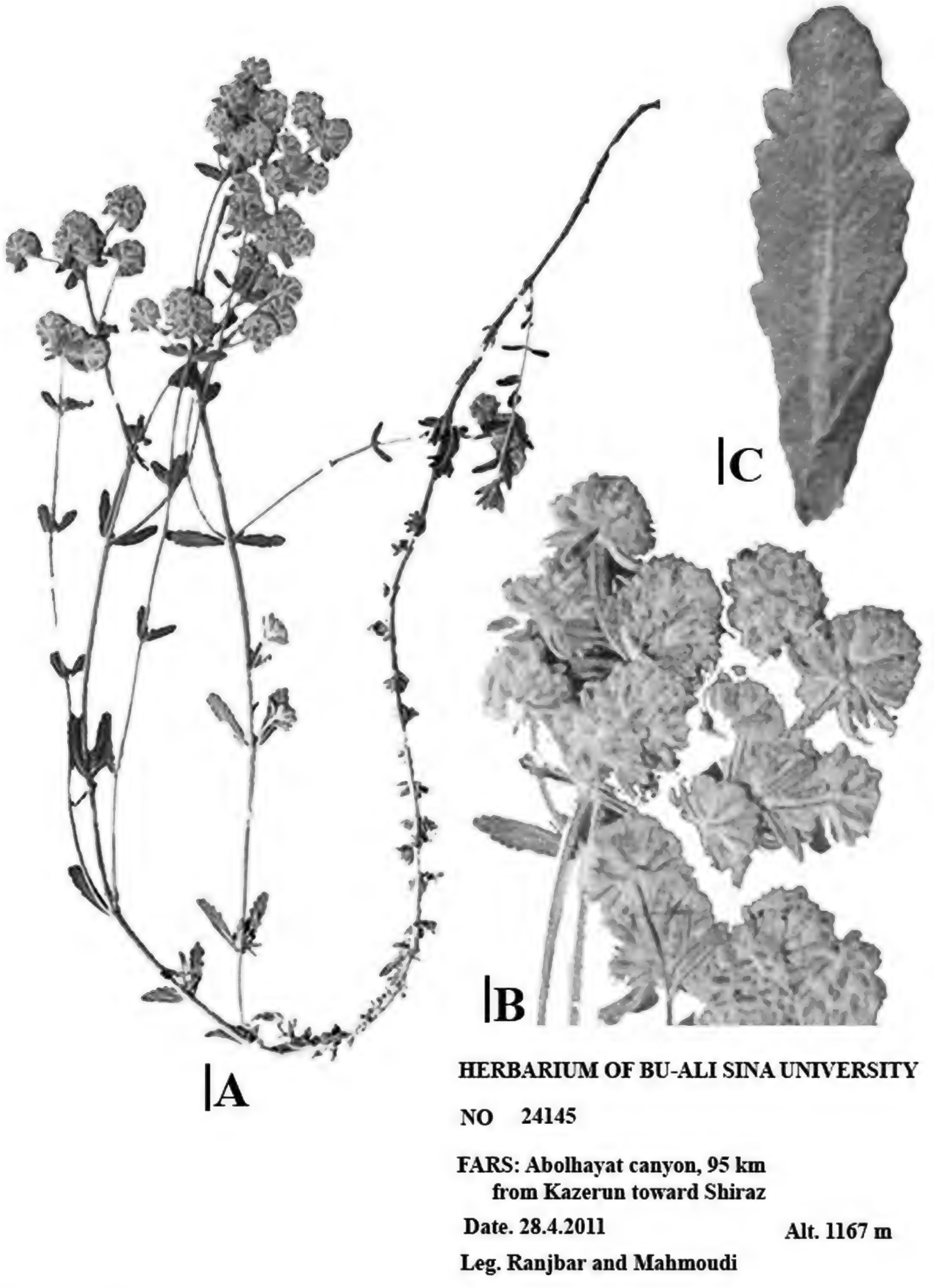

Figure 2. *Teucrium abolhayatensis* Ranjbar & Mahmoudi. —A. Habit. —B. Inflorescence. —C. Leaf. Scale bars: A = 2 cm; B = 0.5 cm; C = 0.3 cm. A–C photographed from the holotype, *Ranjbar & Mahmoudi 24145* (BASU).

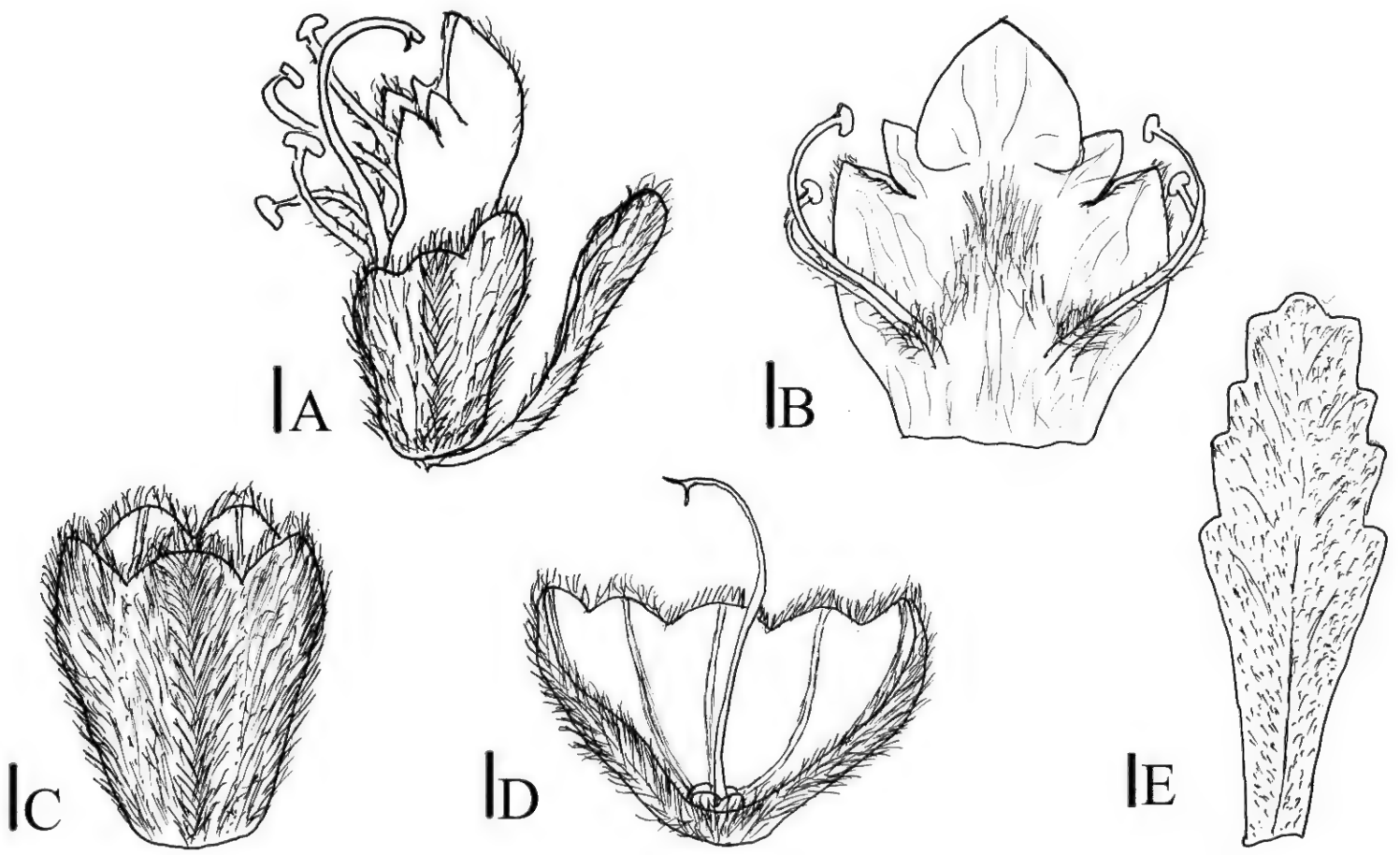

Figure 3. A–E. *Teucrium abolhayatensis* Ranjbar & Mahmoudi. —A. Flower, lateral view. —B. Open corolla. —C. Calyx. —D. Open calyx. —E. Leaf. F–J. *Teucrium polium* L. —F. Flower, lateral view. —G. Open corolla. —H. Calyx. —I. Open calyx. —J. Leaf. Scale bars: A–E = 0.1 cm; F–J = 0.1 cm. A–E drawn by Nazari from the holotype, *Ranjbar & Mahmoudi 24145* (BASU); F–J drawn by Nazari from *Ranjbar & Mahmoudi 34879* (BASU).

with slightly prominent nerves, ± distinctly reticulate-veined. Inflorescence 1–2 cm, forming a flower head with 10 to 12 flowers, subspherical to spiciform, rarely branched, terminal on long shoots, sometimes subtended by 4 to 5 smaller, subsessile heads. Bracts foliaceous, pale green grayish, slightly suffused with lilac, 5–6 × 0.5–1 mm, oblong-lanceolate, with revolute margins, entire. Flowers sessile or shortly

Table 1. Morphological comparison of *Teucrium abolhayatensis* Ranjbar & Mahmoudi, *T. gnaphalodes* L'Hér., and *T. polium* L.

	T. abolhayatensis	*T. gnaphalodes*	*T. polium*
Plant height	50–60 cm	10–15 cm	20–45 cm
Stem indument	grayish, very densely covered with long trichomes, with a few glandular trichomes	white, crisped or appressed, eglandular, intermixed with spreading, long or short, glandular ones	dense, white, crisped or appressed, eglandular, unbranched trichomes, intermixed with spreading, long or short, glandular ones
Leaf color	gray or whitish	green or yellowish	olive-green
Leaf shape	oblong or oblong-linear	triangular-oblong	oblong-lanceolate, lanceolate, or lanceolate-linear
Leaf size	12–20 × 3–7 mm	8–10 × 2–3 mm	10–12 × 2–3 mm
Leaf margin	crenate-dentate, with 4 to 5 acute teeth on each margin	toothed, crenate, or lobed on the apical 1/2	lower 1/2–3/4 entire or somewhat sinuate-undulate, upper 1/4–1/2 with an apical tooth and 2 to 4 crenations on either side
Inflorescence size	1–3 cm	1.5–3 cm	3–15 cm
Flowers per verticillaster	10 to 17	(2 to)4 to 8(to 10)	(3 to)5 to 7(to 10)
Calyx color and indument	grayish, woolly-tomentose, densely covered with long trichomes	usually green, tomentose with glandular hairs and branched trichomes	green, pubescent or tomentose with intertwined branched trichomes, rarely with simple trichomes
Calyx teeth	equal, ovate-oblong with apex obtuse, 1.2–1.5 × 0.6–0.8 mm	unequal, triangular-obtuse with apex acuminate to mucronate, 1–1.2 × 0.5–0.6 mm	unequal, triangular-obtuse with apex acuminate to mucronate, 1–1.8 × 0.5–0.7 mm
Corolla basal lobes	1.3–2 × 0.6–0.8 mm	1.5–2 × 0.7–0.8 mm	1.2–2 × 0.5–0.8 mm
Corolla shape	basal lobes appressed to the lateral lobe	basal lobes appressed to the lateral lobe	basal lobes distant to the lateral lobe
Corolla color	yellow	cream, pink, or purple	white or cream-colored

petiolate. Calyx ± obliquely campanulate, 4–6 mm; tube curved, 3–3.5 × 1.5–1.8 mm, 5-nerved, reticulately veined, grayish, tomentose with long and intertwined branched trichomes, rarely with spreading or appressed, unbranched, eglandular indument, usually gland-dotted; teeth somewhat equal, triangular or triangular-lanceolate with apex acuminate, 1–1.2 × 0.5–0.6 mm. Corolla violet or pale purple, external surface glandular strigose and densely pubescent distally, hirsute at the lateral lobes; tube 2.1–4.8 × 0.6–0.9 mm, slightly curved; limb 3.2–4.5 mm, basal lobes distant to the lateral lobe, semicircular, 1–1.5 × 0.5–0.6 mm, with hirsute posterior margin and glandular hairs in the anterior margin; lateral lobes distant to the median lobe, oblong, 1–1.1 × 0.5–0.6 mm; median lobe somewhat cucullate, 1.5–2 × 1.5–1.6 mm. Filaments thinly pilose, adaxial 2.2–2.5 mm, abaxial 3–4.2 mm; anthers purple, 0.5–0.7 mm. Ovary glabrous, 0.6–0.8 mm; style glabrous, 5–5.5 mm; stigmatic lobes subulate, subequal, 0.5–0.6 mm. Nutlets dark brown, somewhat obovate, 1–1.2 × 0.6–0.8 mm, granulose, distinctly reticulately veined and foveolate, apex rounded, base wedge-shaped, attachment area flat, orbicular, 0.9–1 mm diam., adjacent area convex.

Phenology. *Teucrium gabrielae* flowers between late March and early June.

Distribution and ecology. *Teucrium gabrielae* occurs near the Oman Sea and the Persian Gulf in Iran. The species is endemic to warm, arid and semi-arid regions in southern and southeastern Iran, growing on stony slopes, in low and mid-montane zones, at elevations of 500–2300 m. The type location of *T. gabrielae* is the dry-stony zone around Taftan Mountains ("Taftan" means hot and molten) near the Khash area at Sistan and Baluchestan Province, southeastern Iran (Fig. 1). The species forms a community with several other cushion-forming plants of the steppe vegetation in the area, such as species of *Astragalus* L.

IUCN Red List category. *Teucrium gabrielae* is known from a few small populations, consisting of no more than 20 plants in all populations. It was observed to be sparsely scattered in Baluchestan and

Table 2. Morphological comparison of *Teucrium gabrielae* Bornm. and *T. stocksianum* Boiss.

	T. gabrielae	*T. stocksianum*
Plant height	10–25 cm	10–30(–40) cm
Stem indument	white to gray, very densely covered with long indument	green, densely covered with short, slightly crisp trichomes
Leaf shape	lanceolate	narrowly elliptic, oblong, or obovate
Leaf margin	entire	crenate-dentate with 3 to 5 teeth toward apex or subentire
Bract margin	entire	shallowly crenate with 2 to 4 mostly obtuse teeth per side
Bract color	pale green grayish, slightly suffused with lilac	greenish
Corolla color	violet or pale purple	yellow or white-lilac
Corolla indument	external surface glandular strigose and densely pubescent distally, hirsute at the lateral lobes	external surface gland-dotted and thinly pubescent distally, glabrous at the lateral lobes

Kerman Provinces. According to the IUCN Red List criteria (IUCN, 2001), this species may be classified as Critically Endangered (CR D). This category includes taxa with fewer than 50 mature individuals.

Discussion. Bornmüller (1939) described *Teucrium gabrielae* as a distinct species. Rechinger (1982) and Jamzad (2012) reduced the taxon to a subspecies and variety of *T. stocksianum* respectively and published new combinations. After a thorough examination of the protologue (Bornmüller, 1939) and a careful analysis of type specimens, we accepted *T. gabrielae* at the species level. Although it is morphologically similar to *T. stocksianum*, especially because of the resemblance in habit and inflorescence, it differs in many characters, including stem indument, leaf size and shape, bract margin and color, and corolla size and color (Table 2; Figs. 4, 5).

No holotype designation was made in the protologue of *Teucrium gabrielae*, and no one has proposed any nomenclatural type thereafter. According to the protologue, the species was described based on specimens collected by Gabriel. Since specimens of Gabriel have been found at B, where the original material should be, the collection *Gabriel 108* from B, which agrees in all respects with the protologue of *T. gabrielae*, is selected as the lectotype.

Selected specimens examined. IRAN. **Hormozgan:** Bandar-e Abbas, 45 km from bifurcate Minab-Rudan rd. to Kahnuj, 500 m, s.d., *Mozaffarian 39504* (TARI). **Kerman:** 74–100 km a bifurcatione Khash-Iranshahr to Bazman, 1600 m, s.d., *Rechinger 54952* (W image). **Sistan and Baluchestan:** Taftan Mtns., Kharestan, 2200 m, s.d., *Mozaffarian 53023* (TARI); E Bazman, 1700–2000 m, s.d., *Rechinger 55108* (W image); in saxosis 10–18 km N Bazman, 1000–1200 m, s.d., *Rechinger 55044* (W image).

3. Teucrium gnaphalodes L'Hér., Stirp. Nov., 84. 1788. *Teucrium polium* L. subsp. *gnaphalodes* (L'Hér.) Masclans ex O. Bolòs & Vigo, Collect. Bot. (Barcelona) 14: 92. 1983. *Teucrium polium* L. var. *gnaphalodes* (L'Hér.) Benth., Labiat. Gen. Spec. [fasc. 7]: 686. 1835. TYPE: Spain: "Teucrium gnaphalodes / Polium montanum gnaphalodes / incanum flore rubro supinum / Barrl. 338. ic. 1083. / Polium montanum V purpureo flore / Clus. hist. 362," *Vahl s.n.* (lectotype, designated by Ferrer-Gallego et al. [2012a: 38], G-DC [G00210216] image!).

Perennial herb, 10–15 cm tall, with erect or suberect stems, branched from the base, ascending or spreading, indumentum of dense, white, crisped or appressed eglandular trichomes, intermixed with spreading, long or short glandular ones. Leaves subsessile or shortly petiolate, triangular-oblong, cuneate or subcordate, 8–10 × 2–3 mm, green or yellowish on both sides, margins slightly revolute, toothed, crenate, or lobed on the apical 1/2, with oblong lobes, both surfaces with sessile glands, with dense, white, branched, spreading or subappressed, short or long, glandular and eglandular trichomes. Inflorescence 1.5–3 cm, forming a flower head with (2 to)4 to 8(to 10) flowers, spherical or obconical, slightly rounded, by the end of the flowering period often slightly elongated and ovoid, terminal on long shoots or on lateral, long or short branches. Bracts foliaceous, greenish, 3–4.5 × 0.5–1 mm, linear, narrowly oblong, with revolute margins, pinnate, crenate or lobed on the apical 1/3. Flowers sessile or shortly petiolate. Calyx tubular, 4.5–5.5 mm; tube curved, 5-nerved, reticulately veined, green, pubescent or tomentose with branched trichomes, rarely with simple trichomes; teeth equal, triangular-obtuse with acuminate to mucronate apex, 1–1.2 × 0.5–0.6 mm. Corolla cream, pink, or purple; tube 3–4 × 0.5–1 mm; limb 4.5–6 mm; basal lobes yellowish, appressed to the lateral lobe, oblong, 1.5–2 × 0.7–

Figure 4. *Teucrium gabrielae* Bornm. —A. Habit. —B. Bract. —C. Leaf. Scale bars: A = 0.8 cm; B, C = 0.1 cm. A–C drawn by Nazari from the holotype, *Gabriel 108* (B).

0.8 mm, with glandular trichomes, with ciliate posterior margin and glandular trichomes in the anterior margin; lateral lobes appressed to the median lobe, oblong, 1–1.5 × 0.3–0.5 mm; median lobe nearly circular, 1.5–2.5 × 1.5–2 mm. Filaments pilose, adaxial 1.5–3.5 mm, abaxial 2.2–5 mm; anthers pinkish violet, 0.3–1.2 mm. Ovary glabrous, ca. 0.7–0.9 mm; style thinly pubescent, 5–6.2 mm; stigmatic lobes subulate, unequal, 0.6–1 mm. Nutlets dark brown to blackish, somewhat cochleariform to

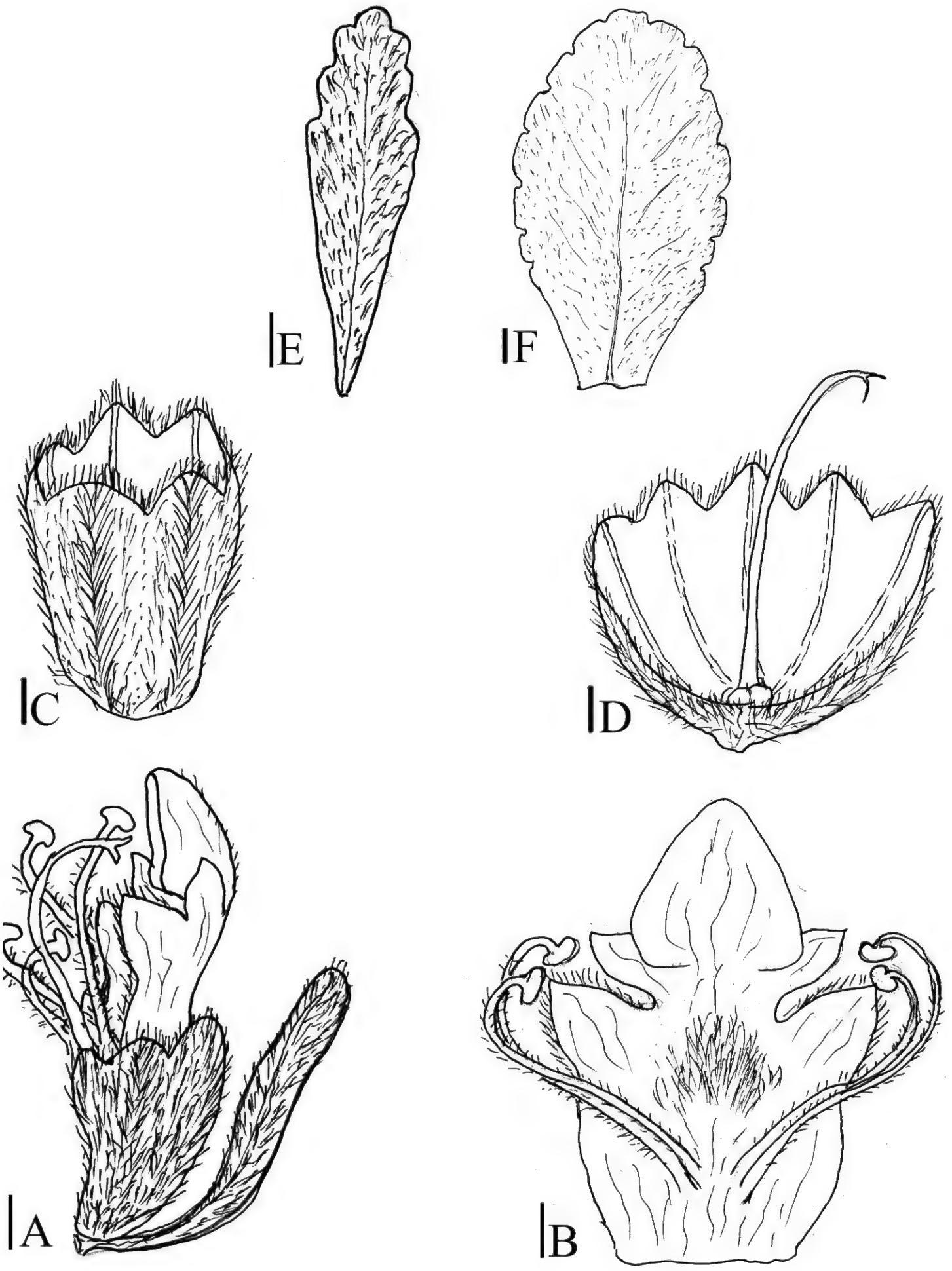

Figure 5. *Teucrium stocksianum* Boiss. subsp. *stocksianum*. —A. Flower, lateral view. —B. Open corolla. —C. Calyx. —D. Open calyx. —E. Leaf. —F. Bract. Scale bars: A–F = 0.1 cm. A–F drawn by Nazari from *Ranjbar & Mahmoudi 29109* (BASU).

obovate, 1.5–2.6 × 0.5–0.8 mm, granulose, slightly reticulately veined and foveolate, apex rounded, base wedge-shaped, attachment area flat, suborbicular, 0.5 × 0.8 mm diam., adjacent area convex.

Phenology. *Teucrium gnaphalodes* flowers between early April and late June.

Distribution and ecology. *Teucrium gnaphalodes* occurs across the Iberian Peninsula and in Iran and Iraq. It could be considered a disjunct species. It occurs in clay soil in mountains, among scattered pine and oak trees or along roadsides (Ferrer-Gallego et al., 2012b). In Iran the plant is a common (or at

least much-collected) species and found on rocky slopes at an elevation of 500–2500 m.

IUCN Red List category. This is a widespread species with no known major widespread threats and is unlikely to be declining fast enough to qualify for listing in a threatened category. It is therefore assessed as Least Concern (LC), according to IUCN Red List criteria (IUCN, 2001).

Discussion. Bentham (1835) treated *Teucrium gnaphalodes* as a variety of *T. polium*, which was followed by Rechinger (1982). However, Ferrer-Gallego et al. (2012a) and Navarro (2010) have recognized this taxon at the rank of species. We concur with that opinion.

Selected specimens examined. IRAN. **Bushire:** Bandar-e Kangan, Punk, 10 m, s.d., *Mozaffarian 44466* (TARI). **Sistan and Baluchestan:** 18 km N Bazman, 1000–1200 m, s.d., *Rechinger 55045* (W image); Bazman, 1000 m, s.d., *Rechinger 54987* (W image). IRAQ. **Kurdistan:** Diyala, 10 km E Mandali, s.d., *Rechinger 9656* (W image).

4. Teucrium polium L., Sp. Pl., 566. 1753. *Chamaedrys polium* (L.) Raf., Fl. Tellur. 3: 85. 1837. TYPE: s. loc., s.d., *LINN 722.35* (lectotype, designated by Siddiqi [1985: 25], L image!).

Perennial herb, 20–45 cm tall, with erect or suberect stems, branched from the base with numerous erect, ascending or spreading branches; indumentum of dense, white, crisped or appressed, eglandular, unbranched trichomes, intermixed with spreading, long or short, glandular ones. Leaves subsessile or shortly petiolate, oblong-lanceolate, lanceolate, or lanceolate-linear, acute, 10–12 × 2–3 mm when fully open, olive green on both sides, becoming yellowish green with age, margins slightly revolute, lower 1/2–3/4 entire or somewhat sinuate-undulate, upper 1/4–1/2 with an apical tooth and 2 to 4 crenations on either side, both surfaces with sessile glands, at first with lax to dense, white, branched, spreading or subappressed, short or long, glandular and eglandular trichomes, becoming appressed and crisped with age. Inflorescence 3–15 cm forming a flower head with (3 to)5 to 7(to 10) flowers, obpyramidal or obconical, flat-topped or slightly rounded, by the end of the flowering period often slightly elongated and ovoid, terminal on long shoots or on lateral, long or short branches, sometimes subtended by 2 to 4 smaller, subsessile heads. Bracts foliaceous, greenish, 4.5–7.5 × 0.5–1.3 mm, linear, narrowly oblong or oblanceolate, with revolute margins, entire except for an apical tooth. Flowers sessile or shortly petiolate. Calyx tubular, (2–)2.3–3.5(–4) mm; tube curved, 3–4.1 × 1.5–1.8 mm, 5-nerved, reticulately veined, green, pubescent or tomentose with intertwined branched trichomes, rarely with simple trichomes; teeth unequal, triangular-obtuse with apex acuminate to mucronate, 1–1.8 × 0.5–0.7 mm. Corolla white or cream-colored; tube 2.5–5 × 0.8–1.3 mm; limb 3–5 mm; basal lobes distant to the lateral lobe, oblong, 1.2–2 × 0.5–0.8 mm, with glandular trichomes, yellowish, with glabrous posterior margin and glandular trichomes in the anterior margin; lateral lobes appressed to the median lobe, oblong, 1.2–1.3 × 0.4–0.6 mm; median lobe nearly circular, 1.5–2 × 1.2–2.1 mm. Filaments thinly pilose, adaxial 1.3–3.7 mm, abaxial 2.5–5.3 mm; anthers pinkish violet, 0.5–1 mm. Ovary glabrous, ca. 0.5–0.8 mm; style thinly pubescent, 4.5–6 mm; stigmatic lobes subulate, unequal, 0.5–0.9 mm. Nutlets dark brown to blackish, somewhat cochleariform to obovate, 1.1–1.3 × 0.7–0.9 mm, granulose, slightly reticulately veined and foveolate, apex rounded, base wedge-shaped, attachment area flat, suborbicular, 0.6 × 0.7 mm diam., adjacent area convex.

Phenology. *Teucrium polium* flowers between late April and early July.

Distribution and ecology. *Teucrium polium* occurs across the Mediterranean region, in southern Europe, North Africa, and southwest Asia. An Irano-Turanian element, the species is common in western, northern, and central Iran in alpine to subalpine areas. It grows in semi-steppe shrublands, shrub-steppes, deserts, and extreme deserts among other cushion-forming plants such as *Astragalus* spp., *Acantholimon* Boiss. spp., and *Daphne mucronata* Royle, at an elevation of 1000–3000 m. *Teucrium polium* is a very variable species. Polymorphism within the species makes it difficult to recognize in some areas. In Iran it is easily identified through the arrangement of the flowers, stem indument, and leaf margins as well as leaf shape.

IUCN Red List category. *Teucrium polium* is a widespread and abundant species, so it is considered of Least Concern (LC) by IUCN Red List criteria (IUCN, 2001).

Traditional and medicinal uses. *Teucrium polium* has commonly been used as an herbal medicine to treat a variety of conditions, including diabetes, inflammation, seizures, insect bites, and bacterial infections. Its leaves have also been used in steam baths for colds and fevers and in herbal teas. However, there is evidence that extracts of this plant

can cause hepatitis (Jongbloed, 2003; Fletcher, 2007; Savvidou et al., 2007; Barceloux, 2008).

Selected specimens examined. IRAN. **Azarbaijan-e Sharqi [East Azerbaijan]:** Khalkhal to Ardebil, toward Nour Lake, 1900 m, 5 June 2010, *Ranjbar 31073* (BASU); Bazargan toward Ghosh, Yarem Qiyeh protected area, 1745 m, 25 May 2011, *Ranjbar & Mahmoudi 27822* (BASU); 5 km after Showt toward Chaldoran, 1945 m, 25 May 2011, *Ranjbar & Mahmoudi 23100* (BASU); Tabriz to Marand, after Sufian, 1500 m, s.d., *Asadi & Mozaffarian 29820* (TARI). **Fars:** Fasa, Azad University, 1840 m, s.d., *Ranjbar & Mahmoudi 29960* (BASU); Firuzabad, after Reycan Village, s.d., *Ranjbar & Mahmoudi 22755* (BASU). **Gilan:** Rustamabad, Bareh Sar before Chareh, 279 m, s.d., *Ranjbar 34879* (BASU). **Hamedan:** Hamedan to Ghorve, before Veinesar Village, 1830 m, 16 May 2011, *Ranjbar & Mahmoudi 24758* (BASU); Toyserkan, 5 km after Ski, 1467 m, 25 June 2011, *Ranjbar & Mahmoudi 26446* (BASU). **Kurdistan:** 15 km after Salvat Abad neck, 2038 m, 19 June 2011, *Ranjbar & Mahmoudi 29227* (BASU); after Salvatabad Village, 5 km to Sanandaj, 1485 m, 16 May 2011, *Ranjbar & Mahmoudi 12449* (BASU). **Lorestan:** Borujerd Mtns., 2000 m, 20 Feb. 2006, *Ranjbar 12378* (BASU). **Mazandaran:** Haraz rd., 2350 m, s.d., *Asadi & Salehi 31766* (TARI).

5. Teucrium stocksianum Boiss., Diagn. Pl. Orient., ser. 2, 4: 58. 1859. TYPE: Pakistan. Baluchistan, Hurbab in montibus Kala, 4500 ft., *Stocks 810* (lectotype, designated here, G-Boiss [G00330629], image!; isolectotype, K [2 sheets pro maj. parte, K000881537, K000881538, and K000881540 and K000881541 and K00088543] image!).

Perennial herb, 10–30(–40) cm tall, with erect or suberect stems, simple or branched from the base with numerous erect, ascending branches, indumentum green, stiff and spreading or short and appressed. Leaves sessile or subsessile, narrowly elliptic, oblong, or obovate, 1.2–2 × 0.4–1 cm when fully open, grayish white on both sides, base cuneate, apex obtuse to acute, margins crenate-dentate with 3 to 5 teeth toward apex or subentire, both surfaces tomentose, denser abaxially and with sessile oil globules at first with lax to dense, white, branched, spreading or subappressed, short or long, glandular and eglandular trichomes, becoming appressed and crisped with age. Inflorescence 1–5 cm, forming a flower head with 6 to 10 flowers, subspherical to spiciform, rarely branched, terminal on long shoots or lateral branches, sometimes subtended by 4 to 5 smaller, subsessile heads. Bracts foliaceous, greenish, 5–7 × 0.5–1.2 mm, narrowly obovate or oblong, with revolute margins, shallowly crenate with 2 to 4 mostly obtuse teeth per side. Flowers sessile or shortly petiolate. Calyx ± obliquely campanulate, 5–7.5 mm; tube curved, 3–4 × 1.8–2 mm, 5-nerved, reticulately veined, green grayish, tomentose with long and intertwined branched trichomes, rarely with spreading or appressed, eglandular indument, usually gland-dotted; teeth subequal, triangular or triangular-lanceolate with acuminate apex, 1–1.5 × 0.6–0.7 mm. Corolla yellow or white-lilac, external surface gland-dotted and thinly pubescent distally, glabrous at the lateral lobes; tube 2.2–5.2 × 0.7–1.2 mm, limb 3.5–5.5 mm; basal lobes distant to the lateral lobe, semicircular, 1–1.8 × 0.5–0.7 mm, with hirsute posterior margin and glandular trichomes in the anterior margin; lateral lobes appressed to the median lobe, oblong, 1.1–1.2 × 0.5–0.7 mm; median lobe 1.5–2.2 × 1.5–9 mm, somewhat cucullate. Filaments thinly pilose, adaxial 2.5–2.8 mm, abaxial 3–4.5 mm; anthers purple, 0.6–0.8 mm. Ovary glabrous, 0.7–1 mm; style glabrous, 5–6 mm; stigmatic lobes subulate, subequal, 0.5–0.6 mm. Nutlets dark brown to blackish, somewhat cochleariform to obovate, 1.2–1.5 × 0.6–0.7 mm, granulose, distinctly reticulately veined and foveolate, apex rounded, base wedge-shaped, attachment area flat, suborbicular, 0.8–0.9 mm diam., adjacent to the attachment area convex.

Phenology. *Teucrium stocksianum* flowers between late April and early July.

Distribution and ecology. *Teucrium stocksianum* is found in Iran, Afghanistan, Pakistan, and Arabia. In Iran the plant is a common (or at least much-collected) species and found in rocky habitats: wadis, hillsides, and compact, fine-textured soils with stones at an elevation of 700–2500 m.

Discussion. *Teucrium stocksianum* is polymorphic in several noteworthy characters, especially in stem and calyx indument. We therefore maintain the recognition of three subspecies.

No holotype designation was made in the protologue of *Teucrium stocksianum* (Boissier, 1859), and no one has proposed any nomenclatural type thereafter. The protologue of *T. stocksianum* cites one collection, with no collection number provided in the protologue or consequently in *Flora Iranica* (Rechinger, 1982) and *Flora of Iran* (Jamzad, 2012). After a thorough examination of specimens at different herbaria, we determined that *Stocks 810* is the original material (Lesley Walsingham, pers. comm.; Laurence Loze, pers. comm.) used by Boissier. Duplicates were located at G and K; since Boissier worked at G, the duplicate there is preferred as lectotype. Material at K is mounted on two sheets, each of which contains plants definitely or possibly from that collection along with material of *T. stocksianum* subsp. *patulum* (Hedge & Lamond) Rech. f., probably of different origin; multiple barcodes are therefore affixed to each sheet.

Traditional and medicinal uses. In folk medicine the plant is an astringent, expectorant, tonic, depurative, febrifuge, stimulant, vulnerary, appetizer, and hypoglycemic agent. An infusion of aerial parts is used for stomachache and intestinal problems, female sterility, and malaria, and a steam bath is used for colds and fever. In the United Arab Emirates the plant is very well known and used for skin, stomach and kidney problems, renal colic, colds, fever, and diabetes (Jongbloed, 2003; Fletcher, 2007; Savvidou et al., 2007; Meshkibaf et al., 2010).

KEY TO *TEUCRIUM STOCKSIANUM* SUBSPECIES

1a. Indumentum on stem and leaves of stiff, spreading trichomes ..... 5c. *T. stocksianum* subsp. *patulum* (Hedge & Lamond) Rech. f.
1b. Indumentum on stem and leaves of short, crisp, appressed trichomes.
  2a. Indumentum on calyx, stem, and leaves all similar, crisp, appressed, and curling; corolla yellow ..... 5a. *T. stocksianum* subsp. *stocksianum*
  2b. Indumentum on calyx covered with long, straight trichomes; corolla white-lilac ..... 5b. *T. stocksianum* subsp. *incanum* (Aitch. & Hemsl.) Rech. f.

5a. Teucrium stocksianum subsp. **stocksianum.**

Distribution and ecology. *Teucrium stocksianum* subsp. *stocksianum* occurs near the Oman Sea and the Persian Gulf in Iran, Pakistan, Oman, and the United Arab Emirates. The subspecies is common in southern and southeastern Iran, growing in plains and on mountain slopes.

IUCN Red List category. *Teucrium stocksianum* subsp. *stocksianum* is a widespread and abundant taxon and is considered of Least Concern (LC) by IUCN Red List criteria (IUCN, 2001).

Selected specimens examined. IRAN. **Bandar-e Abbas:** Siaho Region, 1200 m, s.d., *Mozaffarian 39707* (TARI); 85 km to Sirjan, 750 m, s.d., *Wendelbo & Foroughi 15752* (TARI). **Fars:** Sepidan to Nourabad, 12 km to Dolatabad, Hasani area, 1600 m, 18 May 2010, *Ranjbar 22259* (BASU). **Lurestan:** Dorud, 10 km after Natural Resources Office, 1602 m, 18 June 2014, *Ranjbar 29353* (BASU); Dorud, Sarvand bifurcate, 2127 m, s.d., *Ranjbar & Mahmoudi 29109* (BASU); Lar, Hajjiabad & Bandar Abbas ad jugum Gohreh (Guhra), 700 m, s.d., *Rechinger 3326* (W image).

5b. Teucrium stocksianum subsp. **incanum** (Aitch. & Hemsl.) Rech. f., Fl. Iranica 150: 29. 1982. Basionym: *Teucrium incanum* Aitch. & Hemsl., J. Linn. Soc., Bot. 19: 184. 1882. *Teucrium stocksianum* var. *incanum* (Aitch. & Hemsl.) Hedge & Lamond, Notes Roy. Bot. Gard. Edinburgh 28: 149. 1968. TYPE: Pakistan. Kurram: betw. Thai & Badishkhel, *Aitchison 444* (holotype, K [K000881544] image!).

Indumentum on calyx covered with long, straight trichomes; corolla white-lilac.

Distribution and ecology. *Teucrium stocksianum* subsp. *incanum* occurs near the Oman Sea and the Persian Gulf in Iran and Pakistan, and also occurs in Afghanistan. The subspecies is known only in southern Iran, growing on mountain slopes.

IUCN Red List category. *Teucrium stocksianum* subsp. *incanum* is known from a few small populations, consisting of no more than 20 plants per population. It was observed to be sparsely scattered in Hormozgan Province. According to the IUCN Red List criteria (IUCN, 2001), this species could be classified as Endangered (EN D). This category includes taxa for which fewer than 250 mature individuals exist.

Selected specimens examined. AFGHANISTAN. **Khost:** in collibus saxosis prope Khost, 1200 m, s.d., *Rechinger 35500* (W image). **Nangarhar:** in parte inferiore vallis Kunar 40–60 km NE Jalalabad, 750–900 m, s.d., *Rechinger 32402* (W image). IRAN. **Hormozgan:** betw. Tarom & Kahgom, 800 m, s.d., *Mozafarian 52291* (TARI); 11 km from Senderk to Dar Pahn, after Arangeh, 450 m, s.d., *Mozaffarian 39169* (TARI). PAKISTAN. **Chitral:** inter Barikot & Mingora, 700–900 m, s.d., *Rechinger 30497* (W image). **Kohat:** 20–30 km W Kohat toward Thal, 500–700 m, s.d., *Rechinger 30200* (W image); Amal Kot & Sadda, 1400 m, s.d., *Rechinger 30975* (W image). **Peshawar:** Landi Kotal, 700–1000 m, s.d., *Rechinger 30317* (W image).

5c. Teucrium stocksianum subsp. **patulum** (Hedge & Lamond) Rech. f., Fl. Iranica 150: 29. 1982. Basionym: *Teucrium stocksianum* var. *patulum* Hedge & Lamond, Notes Roy. Bot. Gard. Edinburgh 28: 148. 1968. TYPE: Pakistan. Quetta, Toskan above Harnai, 900 m, *Rechinger 29476* (holotype, W [W1966-0021535] image!; isotype, M not seen).

Indumentum on stem and leaves of stiff, spreading trichomes.

Distribution and ecology. *Teucrium stocksianum* subsp. *patulum* occurs near the Oman Sea and the Persian Gulf in Iran and Pakistan. The subspecies grows on mountain slopes in southern Iran.

IUCN Red List category. *Teucrium stocksianum* subsp. *patulum* is known from a few small populations, consisting of no more than 20 plants per population. It was observed to be sparsely scattered in Bandar Abbas and Hormozgan Provinces. According to the IUCN Red List criteria (IUCN, 2001), this species could be classified as Endangered (EN D). This category includes taxa for which fewer than 250 mature individuals exist.

Selected specimens examined. IRAN. **Bandar Abbas:** Hajiabad, Shemil Mtns., s.d., *Mozaffarian 552315* (TARI); Ghotb Abad, Baghestan, Dam Tang, 650 m, s.d., *Mozaffarian 59192* (TARI). **Hormozgan:** Ghotb Abad, Baghestan, Damtang, 650 m, s.d., *Mozaffarian 59192* (TARI). PAKISTAN. **Quetta:** 38 km E Gumbaz, 1050 m, s.d., *Rechinger 29679* (W image); inter Loralai & Sanjawi, 1500–1600 m, s.d., *Rechinger 29438* (W image); inter Sanjawi & Hamai, s.d., *Rechinger29457* (W image); Warn Tangi NW Harnai, 1200 m, s.d., *Rechinger 29566* (W image); Dera Ghazi Khan, M. Sulaiman, Fort Munro, 1600–1800 m, s.d., *Rechinger 29737* (W image).

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New Species of *Calceolaria* (Calceolariaceae) from Northern Peru

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Abstract. Two new species of *Calceolaria* L. from northern Peru belonging to section *Teucriifoliae* Kraenzl. are described, illustrated, and compared with their most closely related relatives. These new taxa grow in the province of Bolívar, department of La Libertad, in Peru. *Calceolaria chibulensis* C. Romero, Bussmann & Puppo grows at elevations between 2400 and 2500 m; *C. comulcana* C. Romero, Bussmann & Puppo grows at elevations between 3900 and 4200 m.

Resumen. Dos especies nuevas de *Calceolaria* L. del norte de Perú pertenecientes a la sección *Teucriifoliae* Kraenzl. se describen, ilustran y comparan con sus parientes más cercanos. Estos nuevos taxa crecen en la Provincia de Bolívar, Departamento de La Libertad, en Perú: *C. chibulensis* C. Romero, Bussmann & Puppo entre los 2400 y 2500 m de elevación y *C. comulcana* C. Romero, Bussmann & Puppo entre 3900 y 4200 m.

Key words: *Calceolaria*, Calceolariaceae, IUCN Red List, La Libertad, northern Peru.

Calceolaria L., the largest genus of the Calceolariaceae, includes over 250 species restricted to tropical and temperate Central and South America, distributed from Sierra Madre Occidental in central Mexico to Tierra del Fuego in southern Argentina (Molau, 1988). The majority of *Calceolaria* species grow at elevations between 2000 and 4000 m (ca. 184 species: Molau, 1988, 2003; Puppo, 2008, 2010a), though many species of temperate South America grow at lower elevations and are important members of the coastal vegetation of Argentina, Chile, and Peru. The Peruvian Andes harbor the greatest diversity of the genus in terms of number of species (Molau, 1988; Sérsic, 2004; Andersson, 2006; Puppo, 2008; Madriñán et al., 2013). In northern Peru south of the Huancabamba Deflection, the lowest section of the central Andean Range, there is a great concentration of endemic species (Barthlott et al., 1996; Bussmann, 2006), especially in the departments of Cajamarca and Amazonas (Puppo, 2010b). The great majority of *Calceolaria* species present in the vicinity of the Deflection are restricted to a single valley on one side of the barrier or the other, a favorable scenario for rapid allopatric differentiation to occur (Hughes & Eastwood, 2006; Ackermann et al., 2008; Cosacov et al., 2009; Madriñán et al., 2013). This type of ecogeographic isolation seems to be the main barrier to gene flow and, consequently, is recognized as the primary speciation mechanism in *Calceolaria* (Molau, 1988; Ehrhart, 2005).

The characteristic floral morphology of *Calceolaria* makes it an easily identifiable genus thanks to its two stamens and bilabiate corolla with saccate lower lip that includes an abaxial infold lined with a pad of oil-secreting hairs known as an elaiophore (Molau, 1988; Sérsic, 2004). Only one species, *C. triandra* (Cav.) Vahl, presents a 3-labiate corolla and three stamens. In the most comprehensive treatment of the genus to date, Molau (1988) recognized three subgenera and 22 sections within *Calceolaria*. *Calceolaria* subg. *Calceolaria* is the most abundant in the Neotropics, while *Calceolaria* subgenera *Cheiloncos* (Wettst.) Pennell and *Rosula* (Descole & Borsini) Molau are mainly restricted to temperate South America. This subgeneric classification has been supported by recent phylogenetic and morphological studies, although most of the 22 sections proposed by Molau (1988) were not retrieved as natural groups and, therefore, are in need of a taxonomic revision to redefine their limits (Andersson, 2006; Cosacov et

al., 2009). Since there is no updated classification at the sectional level, the new species of *Calceolaria* described here are temporarily placed within the sections defined by Molau (1988).

Since 2008, we conducted botanical expeditions in northern Peru (department of Amazonas, Chachapoyas Province; department of La Libertad, Bolívar Province; and department of San Martín, Huallaga Province), covering a wide range of areas and during different seasons throughout the year. This area comprises very diverse biogeographic zones, stretching from the dry inter-Andean Marañón valley with elevations as low as 900 m, to dense cloud forests and *Neurolepis* Meisn. páramos between 2000 and 4500 m, and humid forest at the upper reaches of Huallaga Province at 1500–2000 m, on substrates ranging from granite and gneiss to alluvial sandstones and dolomite-rich limestone karst areas (Bussmann, pers. obs.). As a result of these expeditions, a variety of taxa new to science have been identified, including the *Calceolaria* species here described, which belong to subgenus *Calceolaria* as circumscribed by Molau (1988).

Taxonomy

1. Calceolaria chibulensis C. Romero, Bussmann & Puppo, sp. nov. TYPE: Peru. La Libertad: Bolívar, Distr. Uchumarca, Chibul, 06°58′24″S, 77°52′29″W, 2450–2500 m, 12 July 2010 (fl., fr.), *A. Glenn, R. W. Bussmann, C. Vega Ocaña, G. Chait & F. Díaz Vega 598* (holotype, MO!; isotype, HAO!). Figure 1.

Diagnosis. *Calceolaria chibulensis* C. Romero, Bussmann & Puppo is morphologically similar to *C. melissifolia* Benth., but differs by its shorter petioles (< 1 mm long) that are glandular and hirsute-tomentose, sepals densely glandular and hirtellous externally and densely glandular and sparsely hirtellous internally, corolla with lower lip saccate in 50%–60% of its length and anther thecae divaricate or slightly deflexed.

Herb or shrub, 40–60 cm tall. Stems divaricate-terete, glandular, shortly hirsute-tomentose. Leaves decussate, dark green abaxially, lighter green adaxially. Petioles almost obsolete (leaves subsessile), < 1 mm, glandular and hirsute-tomentose. Lamina 0.6–3 × 0.3–1.6 cm, ovate-lanceolate or elliptic, base obtuse or cuneate, sometimes slightly asymmetrical, apex acute or obtuse, margins crenate to deeply crenulate, hirtellous abaxially, pubescent-hirsutulous adaxially; venation pinnate, areolate-reticulate. Inflorescence a compound cyme, densely glandular and hirsute; floral pedicel 0.5–2 cm; cyme bracts present, lanceolate or elliptic, crenulate. Sepals ochre, lanceolate, 4–6 × 1.5–2.5 mm at anthesis, apex acuminate to acute, densely glandular and hirtellous externally, densely glandular and sparsely hirtellous internally. Corolla yellow with red bands between lips; upper lip 2–8 × 2.5–5 mm; inferior lip 1–1.5 × 0.35–1 cm, saccate in 50%–60% of length; elaiophore present. Stamen with 1 theca slightly bigger than the other (thecae unequal); anthers not dehiscing throughout, light yellow, 2.5–3.5 mm across, thecae divaricate or slightly deflexed, each one 1–1.7 mm; filaments 0.7–1 mm. Style arcuate at apex, 1.8–3 mm. Stigma inconspicuous, not expanded. Capsule pyriform, 4–8 mm, ochre, densely glandular-hirtellous.

Phenology. *Calceolaria chibulensis* was recorded flowering and fruiting in July.

Distribution and habitat. *Calceolaria chibulensis* is known from two collections made at the locality of Chibul in the district of Uchumarca (department of La Libertad, Peru), along a river course under a dense Lauraceae cover overstory in areas of montane forest.

IUCN Red List category. Since *Calceolaria chibulensis* is so far known only from two different collections, the lack of data on its distribution and population size is not sufficient to attempt an accurate assessment; therefore, it is classified as Data Deficient or DD (IUCN, 2012).

Etymology. The specific epithet refers to the type locality in Chibul (department of La Libertad) in Peru.

Discussion. For its resemblance to *Calceolaria melissifolia* Benth. (de Candolle, 1846: 214) (see Table 1), *C. chibulensis* is placed in section *Teucriifoliae* Kraenzl. (Engler, 1907: 83). This section has a center of diversity in northern Peru where most of its species occur (Molau, 1988). However, section *Teucriifoliae*, as well as most of the sections within this genus, have been proved to be polyphyletic in molecular studies (Andersson, 2006; Cosacov et al., 2009). Despite *C. chibulensis* being known only from the type locality, it has a unique combination of characters that makes it a distinct species: divaricate branching, stems hirsute-tomentose; leaves subsessile with petioles less than 1 mm, laminas less than 3 cm, margins crenate; corolla with lower lip saccate 50%–60% (type I sensu Molau, 1988); anther thecae divaricate or slightly deflexed, unequal in length, and not dehiscing throughout (type 11 to 12 sensu Molau, 1988).

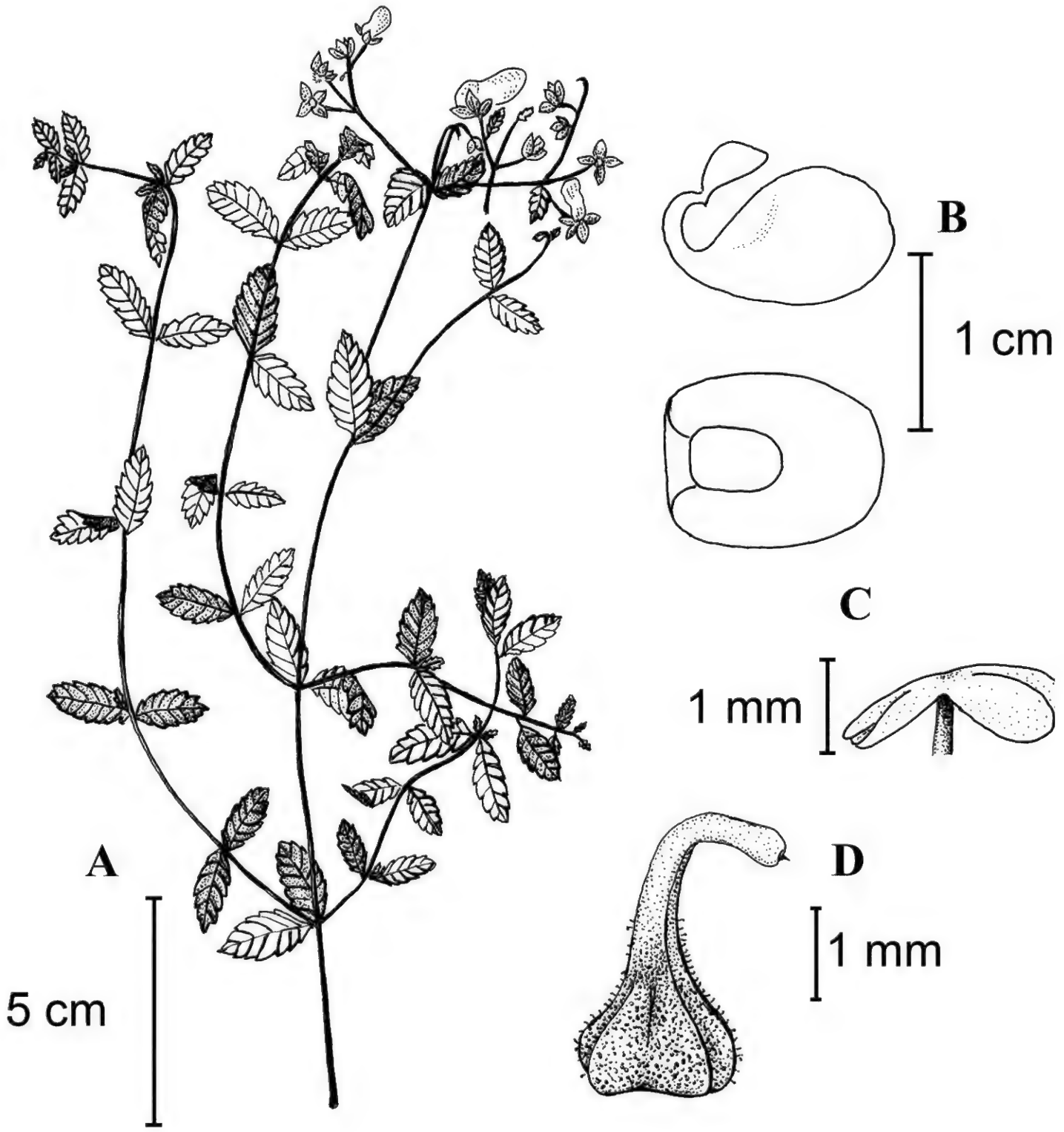

Figure 1. *Calceolaria chibulensis* C. Romero, Bussmann & Puppo. —A. Flowering branch. —B. Corolla (lateral and dorsal views). —C. Stamen. —D. Capsule. A, B, and D drawn from the holotype, *A. Glenn, R. W. Bussmann, C. Vega Ocaña, G. Chait & F. Díaz Vega 598* (MO); C drawn from *Glenn et al. 601* (MO). A–D drawn by Alba L. Arbeláez.

Table 1. Diagnostic morphological characters of *Calceolaria chibulensis* C. Romero, Bussmann & Puppo and *C. melissifolia* Benth.

Character	*C. chibulensis*	*C. melissifolia*
Margin of leaves	straight	revolute
Petiole length (mm)	< 1	2–6
Petiole indument	glandular and hirsute-tomentose	villous to hispid
Sepal color	ochre	green suffused with purple
Sepal indument externally	densely glandular and hirtellous	hispid, hirsute with glandular hairs
Sepal indument internally	densely glandular and sparsely hirtellous	glabrous
Corolla type*	I	XI
Lower lip % saccate	50%–60%	70%–80%
Stamen type*	11 to 12	9
Anther thecae	divaricate or slightly deflexed	divaricate or slightly ascending
Capsule indument	densely glandular-hirtellous	glandular-hirsute

* Corolla and stamen morphology following Molau, 1988.

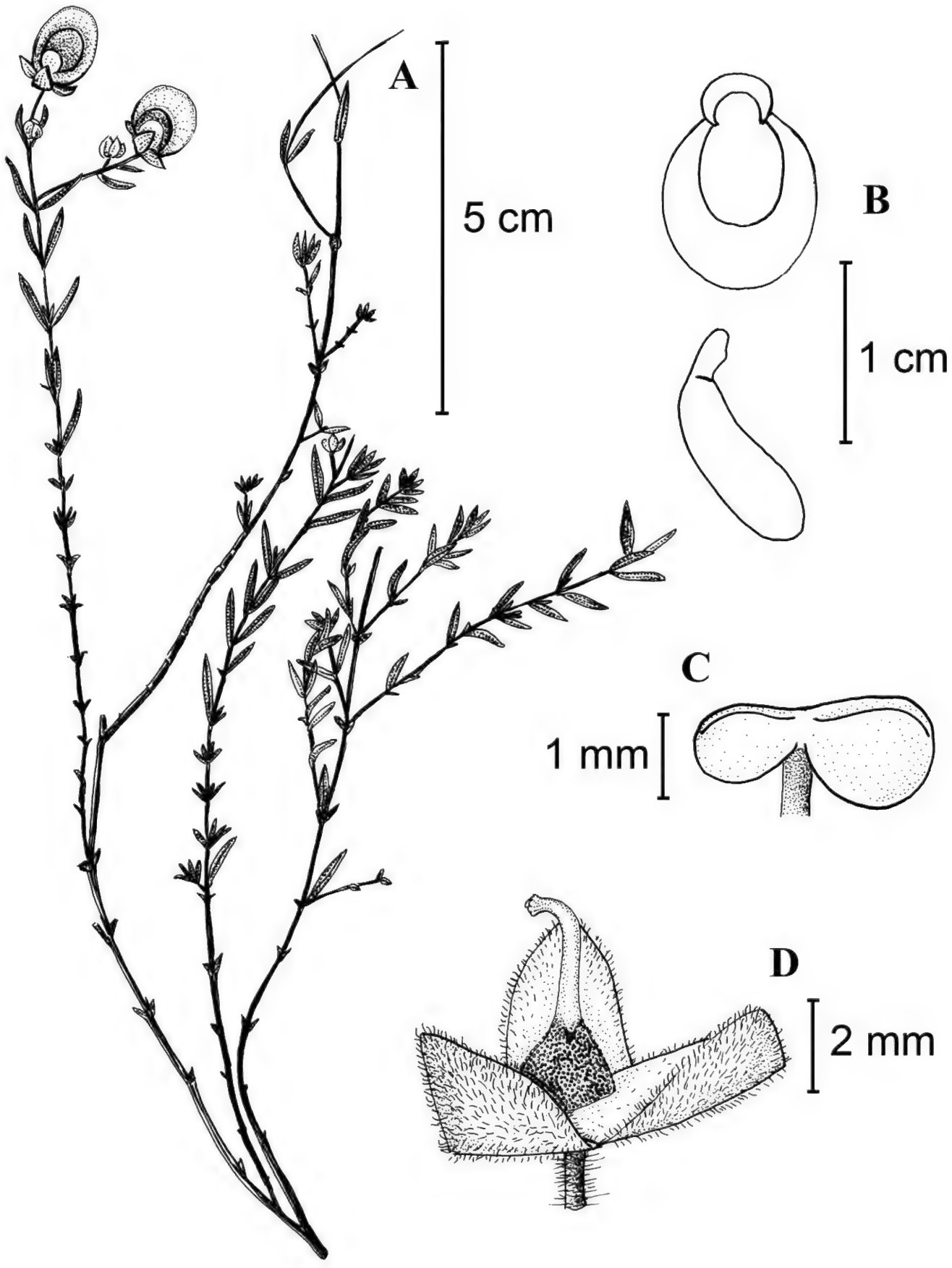

Figure 2. *Calceolaria comulcana* C. Romero, Bussmann & Puppo. —A. Flowering branch. —B. Corolla (dorsal and lateral views). —C. Stamen. —D. Capsule. Drawn by Alba L. Arbeláez from the holotype, *R. W. Bussmann, N. Paniagua Zambrana, C. Vega Ocaña & C. Téllez 18011* (MO).

Paratypes. PERU. **La Libertad:** Bolívar, Distr. Uchumarca, Chibul, 06°58′24″S, 77°52′29″W, 2450–2500 m, 12 July 2010 (fl., fr.), *A. Glenn, R. W. Bussmann, C. Vega Ocaña, G. Chait & F. Díaz Vega 601* (HAO, MO).

2. Calceolaria comulcana C. Romero, Bussmann & Puppo, sp. nov. TYPE: Peru. La Libertad: Bolívar, Distr. Uchumarca, SW flank of Cerro Comulca, 07°04′42″S, 077°46′17″W, 3900–4150 m, 9 Nov. 2013 (fl., fr.), *R. W. Bussmann, N. Paniagua Zambrana, C. Vega Ocaña & C. Téllez 18011* (holotype, MO!; isotype, HAO!). Figure 2.

Diagnosis. *Calceolaria comulcana* C. Romero, Bussmann & Puppo differs from *C. reichlinii* Edwin in its smaller habit (15–20 cm tall), white tomentulose stem indument, subsessile leaves 6–8 mm long, sepals externally densely glandular and crisped tomentulose, corolla with lower lip saccate in 40%–50% of length, elaiophore absent and stamens with unequal and divaricate thecae.

Subshrub, 15–20 cm tall. Stems terete, tomentulose with white hairs. Leaves decussate, arranged on the stem approximately at every 5 mm, dark green abaxially, lighter and white adaxially due to indu-

Table 2. Diagnostic morphological characters of *Calceolaria comulcana* C. Romero, Bussmann & Puppo and related species, including *C. argentea* Kunth, *C. reichlinii* Edwin, *C. laevis* Molau, and *C. weberbaueriana* Kraenzl.

Character	*C. comulcana*	*C. argentea*	*C. reichlinii*	*C. laevis*	*C. weberbaueriana*
Size (cm)	15–20	10–50	20–60	20–60	20–50
Stems indument	white-tomentulose	white-sericeous	arachnoid-lanate	white-villous	villous to arachnoid-lanate
Leaf size (mm)	6–8 × 1–1.5	8–30 × 3–17	8–25 × 2–8	9–19 × 2–6	5–15 × 1–5
Petiole length (mm)	inconspicuous	1–3	1–3	1–2	0–5
Sepal size (mm)	4–5 × 2–3	4–9 × 3–4.5	3.5–8 × 2.5–6	3–6 × 1.5–4	2.5–5 × 1–3.5
Corolla type*	XIV	XI	XI	XI	XV
Elaiophore	absent	present	present	present	absent
Stamen type*	11	9	9	9	10
Anther length (mm)	2.7–2.9	2.5–3	3–5.5	2.9–4	1.6–3.2

* Corolla and stamen morphology following Molau, 1988.

ment. Petioles almost obsolete (leaves subsessile). Lamina 6–8 × 1–1.5 mm, linear, base truncate, apex obtuse to rounded, margins revolute and almost touching opposite margins at the adaxial side, shortly tomentulose abaxially, densely white tomentulose and obscured by the almost touching revolute margins adaxially; venation obscure, not visible. Inflorescence a biflorous cyme, densely glandular and crisped pubescent-tomentulose; floral pedicel 0.8–1 cm; cyme bracts present, linear-lanceolate. Sepals dark ochre, ovate, 4–5 × 2–3 mm at anthesis, apex acute, densely glandular and crisped-tomentulose denser on margins externally, glandular and sparsely tomentulose internally. Corolla dark yellow; upper lip 2 × 4 mm; inferior lip 0.9–1.5 × 0.8–0.9 cm, saccate in 40%–50% of length; elaiophore absent. Stamen with one theca slightly bigger than the other (thecae unequal); anthers not dehiscing throughout, light yellow to cream, 2.7–2.9 mm across, thecae divaricate, each one 1.2–1.6 mm; filaments ca. 1 mm. Style clearly arcuate toward the apex, ca. 3.3 mm. Stigma capitate. Capsule pyriform, 3.5–7 mm, ochre-yellow, glandular and hirtellous.

Phenology. *Calceolaria comulcana* has only been observed flowering and fruiting in November.

Distribution and habitat. *Calceolaria comulcana* is known only from the type collection located in a páramo (puna) region on karst in the district of Uchumarca (Bolívar Province, La Libertad Department) in Peru.

IUCN Red List category. *Calceolaria comulcana* is only known from the type collection; therefore, it is placed here under the Data Deficient (DD) category since information about the species is insufficient to determine a threat category according to IUCN criteria (2012).

Etymology. The specific epithet refers to the type locality in the Cerro Comulca (department of La Libertad) in Peru.

Discussion. *Calceolaria comulcana* is part of a group of species within section *Teucriifoliae* occurring in the north of Peru and characterized by their white pubescence. These species are *C. argentea* Kunth (Kunth, 1818: 387), *C. reichlinii* Edwin (Edwin, 1970: 394), *C. laevis* Molau (Molau, 1984: 637), and *C. weberbaueriana* Kraenzl. (Fedde, 1905: 101). The characters that differentiate *C. comulcana* from these taxa are outlined in Table 2. *Calceolaria comulcana* presents a unique combination of features that makes it clearly a different species: white tomentulose indument; small leaves (less than 8 mm); open corolla lacking an elaiophore; and anther thecae divaricate, unequal in size. This new species is smaller and less pubescent than the related species. The flower morphology of *C. comulcana* is similar to that of *C. weberbaueriana* in that the lower lip is saccate in 40%–50% of its length and lacks an elaiophore (they offer pollen as the only reward to pollinators). However, *C. weberbaueriana* is one of the few species in the genus with purple flowers, while the flowers in *C. comulcana* are dark yellow. These two species also share similar habitats (puna above 3900 m in Bolívar, La Libertad), though *C. weberbaueriana* has also been reported for the departments of Ancash and San Martin. *Calceolaria reichlinii* also grows in La Libertad Department but at lower altitudes (2500–3900 m); *C. argentea* has been reported for Cajamarca and Piura between 2950 and 3900 m, and *C. laevis* is endemic to Cajamarca and grows between 2200 and 3550 m.

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Rubiacearum Americanarum Magna Hama Pars XXXVII: The New Group *Palicourea* sect. *Chocoanae* of the Chocó Biogeographic Region, with Two New Species (Palicoureeae)

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Abstract. *Psychotria* L. subg. *Heteropsychotria* Steyerm. has been shown, based on morphological and molecular analyses, to be polyphyletic. Most of its species, including its type, belong to *Palicourea* Aubl. Several *Psychotria* species studied here are related to species of *Palicourea* ser. 11 and are transferred here to *Palicourea*. *Palicourea* ser. 11 is formally described here as *Palicourea* sect. *Chocoanae* C. M. Taylor, except for four of its former species that are excluded. *Palicourea* sect. *Chocoanae* includes 15 species from Central and South America and is centered in the Chocó biogeographic region of northwestern South America and eastern Panama. *Palicourea* sect. *Chocoanae* includes eight species already classified in this genus: *Palicourea acanthacea* (Standl. ex Steyerm.) C. M. Taylor, *Palicourea deneversii* (C. M. Taylor) Borhidi, *Palicourea dimorphandrioides* (Dwyer) C. M. Taylor, *Palicourea frontinoensis* Cogollo & C. M. Taylor, *Palicourea grandistipula* (Standl. ex Steyerm.) C. M. Taylor, *Palicourea orquidea* C. M. Taylor, *Palicourea sopkinii* C. M. Taylor, and *Palicourea tamaensis* (Standl. & Steyerm.) Steyerm. Four more species transferred into this genus have new nomenclatural combinations made here. *Palicourea cotejensis* (Standl.) C. M. Taylor is based on *Cephaelis cotejensis* Standl.; *Palicourea plusiantha* (Standl.) C. M. Taylor is based on *Psychotria plusiantha* Standl.; *Palicourea timbiquensis* (Standl.) C. M. Taylor is based on *Psychotria timbiquensis* (Standl.) C. M. Taylor; and *Palicourea trianae* (Standl.) C. M. Taylor is based on *Cephaelis trianae* Standl. One species, *Palicourea psilophylla* (Steyerm.) C. M. Taylor, was previously treated as a variety, *Palicourea tamaensis* var. *psilophylla* Steyerm. Two species are newly described here: *Palicourea mistratoana* C. M. Taylor is found in western Colombia and differs from *Palicourea sopkinii* in its smaller leaves, inflorescences, and bracts; and *Palicourea shuar* C. M. Taylor is found in southern Ecuador and differs from *Palicourea sopkinii* by its corymbiform inflorescences and shorter bracts. A lectotype is designated for *Cephaelis grandistipula* Standl. ex Steyerm.

Key words: Colombia, Ecuador, *Palicourea*, Palicoureeae, Panama, Peru, *Psychotria*, Rubiaceae, Venezuela.

Palicourea Aubl. (Rubiaceae, Palicoureeae; abbreviated here as "*Pal.*") comprises a large group of Neotropical species of shrubs and small trees with persistent stipules, animal-pollinated flowers, and blue to purple-black or white, fleshy, drupaceous fruits (Taylor, 1996a, 1997a). This genus has long been considered closely related to the pantropical *Psychotria* L. (abbreviated here as "*Psy.*"), and these genera have been classified together in the tribe Psychotrieae (e.g., Mueller, 1881; Bremer & Eriksson, 2009). However, recent molecular analyses found that this broadly circumscribed tribe, Psychotrieae, included two distinct clades or systematic groups, one comprising only *Psychotria* and the other composed of several genera, including *Palicourea* (Robbrecht & Manen, 2006; Razafimandimbison et al., 2014). These groups have been separated taxonomically by most recent authors, as informal groups of genera (Andersson, 2002) or as two tribes, Psychotrieae s. str. and Palicoureeae (Robbrecht & Manen, 2006; Razafimandimbison et al., 2014). As the separation between *Psychotria* and *Palicourea* has been clarified, morphological (Taylor, 1996a) and molecular (Andersson & Rova, 1999; Nepokroeff et al., 1999; Robbrecht & Manen, 2006; Razafimandimbison et al., 2008, 2014; Paul et al., 2009; Sedio et al., 2013) studies have found that the Neotropical species traditionally classified in *Psychotria* comprise a heterogeneous group. Some of these species do belong to pantropical *Psychotria*, but most belong to the tribe Palicoureeae and within this, to several distinct genera. The Neotropical species that do not belong to *Psychotria* s. str. have been separated in *Psychotria* subg. *Heteropsychotria* Steyerm., which is heterogeneous but mostly comprises a clade that corresponds to *Palicourea* (Taylor, 1996a; Paul et al., 2009; Sedio et al., 2013). Thus, the overall Neotropical group *Palicourea* s.l. is estimated to include about 600 species that have names variously

in *Palicourea* or *Psychotria*, and whose relationships have never been studied together. This present article continues delimitation of *Palicourea* via study of the species of this combined group and nomenclatural transfer of those that were incorrectly classified in *Psychotria* (Taylor et al., 2010; Taylor, 2015a, 2015b). The species included up to now in *Palicourea* are classified in two subgenera and 11 sections (Taylor, 1997a, 2015a, 2015b), and a new section is added here based on this ongoing review of the species of this combined group.

Palicourea was long separated from *Psychotria* subg. *Heteropsychotria* based on corolla characters that are related to pollination mode (Steyermark, 1972; Taylor, 1996a, 1997a). In this older taxonomy *Palicourea* included plants adapted for hummingbird pollination, with brightly colored flowers that are odorless and well separated from each other in brightly colored lax inflorescences and relatively large corollas with well-developed, often curved tubes that are swollen at the base. This swollen basal portion of the corolla contains an appreciable quantity of nectar that is protected from insects by a ring of stiff trichomes, but is accessible to hummingbirds. In contrast, *Psychotria* subg. *Heteropsychotria* included presumably insect-pollinated species, with green to white or pale yellow inflorescences and fragrant flowers that are small and closely grouped. The corollas of species traditionally classified in *Psychotria* generally have short tubes with straight bases that allow small insects to access the nectar. However, there is actually extensive variation in inflorescence and corolla form as well as flower odor and internal pubescence within both *Palicourea* and *Psychotria* subg. *Heteropsychotria* (e.g., Taylor et al., 2004), and the classically cited flower and inflorescence characters do not separate two evolutionarily distinct groups of species. Recent molecular analyses of a number of Rubiaceae genera have found well-supported phylogenetic relationships that show extensive homoplasy in pollination mode and the corresponding morphological adaptations among the different species groups (e.g., Nepokroeff et al., 1999; Malcomber & Taylor, 2009; Mouly et al., 2009), and characters correlated with pollination mode are no longer considered reliable by themselves for separating genera in this family. Molecular analyses have found this pattern of frequent shifts in flower and inflorescence characters associated with pollination mode within many clades of *Palicourea* (Paul et al., 2009; Sedio et al., 2013), although these analyses also suggest that some reproductive characters are consistent within some groups (e.g., Taylor, 2015a). In spite of the broad variation in reproductive characters, the combined group shown by molecular data to comprise *Palicourea* plus most of the species of *Psychotria* subg. *Heteropsychotria* is morphologically well delimited by vegetative and fruit characters (Taylor, 1996a), so species that have not been studied with molecular data can be confidently classified here.

Palicourea in this new, broadened circumscription is characterized by its persistent stipules that are bilobed in their interpetiolar portions; its terminal, basically cymose or thyrsiform inflorescences; its generally 5-merous flowers; its generally inaperturate pollen with thin sexine (Johansson, 1992); and its usually blue to purple-black succulent fruits (Taylor, 1996a, 1997a, 2015a, 2015b; Taylor et al., 2010). However, as in most large genera of Rubiaceae, there is extensive variation and homoplasy in these features: in particular, the stipules are occasionally reduced and/or truncate; the inflorescences vary from laxly paniculiform to densely subcapitate, bracteate to ebracteate, and green to brightly colored; the flowers vary from sessile to long-pedicellate; the corollas range from 1.5 mm to more than 30 mm long; and the fruits range from 3 mm to 30 mm in diameter. The name *Psychotria* subg. *Heteropsychotria* is a taxonomic synonym of *Palicourea*. However, *Psychotria* subg. *Heteropsychotria* was circumscribed based on characters that are widespread and apparently ancestral, which do not reliably diagnose groups of related species. As a result, *Psychotria* subg. *Heteropsychotria* was a systematically heterogeneous group and not all the species classified in it now belong to *Palicourea* s.l. Many species of *Psychotria* subg. *Heteropsychotria* have already been separated into *Notopleura* (Benth.) Bremek. (Taylor, 2001), *Ronabea* Aubl. (Taylor, 2004), *Margaritopsis* C. Wright (Taylor, 2005; i.e., *Eumachia* DC., Applequist, 2014), *Coccochondra* Rauschert (Taylor, 2011), and *Carapichea* Aubl. (Taylor & Gereau, 2013). Transfer of the remaining species of *Psychotria* subg. *Heteropsychotria* to *Palicourea* is thus not automatic, but requires individual study of each species. The genus *Cephaelis* Sw. was previously synonymized with *Psychotria* subg. *Heteropsychotria* (Steyermark, 1972) and its type species apparently now belongs to *Palicourea* s.l. (Taylor & Gereau, 2013: 101–104). However, *Cephaelis* was also diagnosed by a single character, subcapitate inflorescences with well-developed bracts, which is an adaptation for pollination and is now known to be widely homoplasious within the genera of the former Psychotrieae and many other tribes of Rubiaceae (e.g., Mouly et al., 2009; Razafimandimbison et al., 2014). Thus, *Cephaelis*

was also a systematically heterogeneous group, and many of its species do not transfer to *Palicourea*.

Our knowledge of *Palicourea* in this new, broadened circumscription is now restricted by our limited knowledge of its species and species groups. This present article is part of ongoing work to inventory and document the species of this genus, and find an infrageneric classification (Taylor, 1997a, 2015a, 2015b; Taylor et al., 2010) that can be tested with molecular data and further analyzed morphologically. *Palicourea* comprises a large, widespread, relatively recent and thus significant evolutionary radiation of Neotropical plant species, so understanding its diversification, including its centers of species richness, number of sympatric lineages, reproductive and dispersal biology, and the size, ages, and ranges of its lineages, will shed light on Neotropical plant diversity. All such studies depend on a comprehensive documentation of the component species, part of which is provided here for *Palicourea*.

Previous Studies of the Species of *Palicourea* sect. *Chocoanae*

The species included here in the newly named group *Palicourea* sect. *Chocoanae* C. M. Taylor have previously been treated only in floristic works (Standley, 1930; Steyermark, 1974; Taylor, 1999; Lorence et al., 2012) or in studies of selected species (Steyermark, 1964, 1971; Kirkbride, 1980; Taylor, 1994, 1996b, 1997b; Cogollo-P. & Taylor, 1997), and have never previously been studied or classified together. Several of the species studied here were originally described in *Palicourea* and were included by Taylor (1997a) in the infrageneric classification of *Palicourea* as detailed below. Several other species of *Palicourea* sect. *Chocoanae* were initially described in *Cephaelis* based on their capitate or subcapitate inflorescences with well-developed colorful bracts. The other species studied here lack both the characteristic inflorescences of *Cephaelis* and the characteristic flowers of *Palicourea*, and were originally described in *Psychotria*.

Seven of the species included here in *Palicourea* sect. *Chocoanae* were classified by Taylor (1997a: 235–236) in *Palicourea* subg. *Montanae* C. M. Taylor sect. *Cephaeloides* C. M. Taylor ser. 11: *Pal. grandistipula* (Standl. ex Steyerm.) C. M. Taylor, *Pal. tamaensis* (Standl. & Steyerm.) Steyerm., *Pal. sopkinii* C. M. Taylor, *Pal. dimorphandrioides* (Dwyer) C. M. Taylor, *Pal. acanthacea* (Standl. ex Steyerm.) C. M. Taylor, *Pal. frontinoensis* Cogollo & C. M. Taylor, and *Pal. orquidea* C. M. Taylor. This unnamed *Palicourea* ser. 11 was the last group presented in that classification, and to some extent it was composed of species of *Palicourea* subg. *Montanae* C. M. Taylor that did not fit well into the other groups. Its species are better documented now, and seven of them share a distinctive set of characters and are here again grouped together while the other four species of *Palicourea* ser. 11 now seem better classified in other groups. Of the four excluded species, *Pal. skotakii* C. M. Taylor is similar to *Pal. bella* (Standl.) Dwyer and *Pal. ochnoides* Dwyer and thus better included in *Palicourea* ser. 10 with them. *Palicourea macbridei* Standl. was included in *Palicourea* ser. 11 based in part on its supposedly laminar stipules, but recent collections of this species are in better condition and show that its stipules are actually fused around the stem into a tube; their apparently interpetiolar appearance is due to an unusual elongated, membranaceous free upper lobe or portion that wraps around the stem, and can be mistaken for the entire stipule on poorly preserved specimens. *Palicourea macbridei* is similar in stipule form, pedicellate flowers, and corolla form to *Pal. deviae* C. M. Taylor, and thus better classified in *Palicourea* sect. *Montanae* C. M. Taylor ser. 4 subser. e with that species. Also, *Palicourea condorica* C. M. Taylor and *Pal. harlingii* C. M. Taylor were classified in *Palicourea* ser. 11 based mainly on their robust laminar stipules, which are quite similar to those of *Pal. acanthacea*. However, these other two species also have regularly pedicellate flowers and relatively small bracts, and do not now seem closely related to any of the other species of *Palicourea* ser. 11. These two species do have the characters of *Palicourea* subg. *Montanae*, but beyond that do not seem closely related to species of any particular group and so are not currently classified to any section.

The New Group *Palicourea* sect. *Chocoanae*

The 15 species studied here are classified together for the first time in the new group *Palicourea* sect. *Chocoanae*. The new section belongs to *Palicourea* subg. *Montanae* based on its laminar stipules (i.e., with the interpetiolar portion reduced), leaves that are smooth (rather than pustulose) on the lower surface and also often relatively thick textured, and support from molecular sequence analyses that included one of the species studied here, *Pal. acanthacea* (Sedio et al., 2013). As with most infrageneric groups of *Palicourea*, this new section cannot be diagnosed by one or two distinctive features. *Palicourea* sect. *Chocoanae* can, however, be characterized by the combination of several characters: a generally robust habit; well-developed laminar stipules; green or often reddish purple to blue inflorescences with usually well-developed bracts and the flowers subsessile in

congested groups or heads; slender, funnelform to tubular-funnelform, white to blue or purple corollas that are pubescent inside around the middle and sometimes also in the upper part of the tube; axes and pedicels that elongate as the fruits mature; rather small or occasionally medium-sized, purple-black or blue fruits; and pyrenes that are usually abaxially ridged. The inflorescence arrangement found in these species was described in some detail and noted as unusual by Kirkbride in his study of *Pal. trianae* (Standl.) C. M. Taylor (1980: 100–103; as *Psychotria aviculoides* J. H. Kirkbr.). Several of the species of *Palicourea* sect. *Chocoanae* are unusually robust for *Palicourea*, with quite large leaves, stipules, and inflorescence bracts. The species of this new section are found in very wet forests from southern Nicaragua to northern Peru, and also in the Cordillera Oriental of the Andes in eastern Colombia and adjacent western Venezuela. *Palicourea* sect. *Chocoanae* has its center of species diversity in the Chocó region of northwestern South America and eastern Panama (Rangel-Ch., 2004), with 10 of its 14 species found here and most of them restricted to this region. The name of this new section refers to this biogeographic region, which is discussed in more detail below.

Palicourea trianae, *Pal. timbiquensis*, and *Pal. acanthacea* are the most widespread and commonly collected species of *Palicourea* sect. *Chocoanae*. Several other species of this group are currently known from very localized ranges, in particular *Pal. deneversii* (C. M. Taylor) Borhidi, *Pal. orquidea*, *Pal. sopkinii*, and *Pal. mistratoana* C. M. Taylor. However, *Pal. frontinoensis* was also known for some time only from a localized area of northwestern Colombia, but then was also documented from ca. 750 km away in northern Ecuador. The Andean region of western Colombia and Ecuador is poorly known floristically and complicated logistically, and these other species may also be more widely distributed than currently known.

Twelve species of *Palicourea* sect. *Chocoanae* are found in lowland to montane habitats from southern Central America through northern Ecuador. Two species, *Pal. tamaensis* and *Pal. psilophylla* (Steyerm.) C. M. Taylor, are disjunct from there in montane eastern Colombia and western Venezuela, and another species, *Pal. shuar* C. M. Taylor, is disjunct from all of the others in southern Ecuador and northern Peru. *Palicourea tamaensis* and *Pal. psilophylla* are classified here provisionally: these have the characters of this group and do not seem more closely related to any other *Palicourea* species, but their apparent broad range disjunction between different mountain ranges in eastern and western Colombia is quite unusual in *Palicourea*. Similarly, *Pal. shuar* has the characters of this group, does not seem more closely related to any other *Palicourea* species, and is also markedly disjunct in its range from the rest of the group; however, its range disjunction is north–south along the main spine of the Andes, where range extensions both northward and southward are continually being documented in Rubiaceae, e.g., *Pal. frontinoensis*, *Pal. plusiantha* (Standl.) C. M. Taylor, *Psychotria cutucuana* C. M. Taylor.

Morphological Notes on *Palicourea* sect. *Chocoanae*

In addition to the characters of the section mentioned above, some consistent or distinctive morphological features characterize many of the species of *Palicourea* sect. *Chocoanae*, though these features are not restricted to this section. None of the species of *Palicourea* sect. *Chocoanae* were included in Johansson's (1992) study of pollen morphology, nor in Piesschaert's study of pyrene morphology (2001).

Stems and leaves. The leaves of species of *Palicourea* sect. *Chocoanae* are medium-sized to often quite large for *Palicourea*. The largest leaves in this group have blades one third to one half meter long and equally well-developed petioles (e.g., *Pal. acanthacea*, *Pal. cotejensis* (Standl.) C. M. Taylor, *Pal. frontinoensis*, and *Pal. orquidea*). Both average-sized and relatively large leaves in this group also often have relatively numerous secondary veins, to as many as 20 to 44 pairs per leaf (e.g., *Pal. acanthacea*, *Pal. frontinoensis*, *Pal. orquidea*, *Pal. shuar*). Several species of this group have an unusual arrangement of the leaf venation, with numerous secondary veins that are closely set and looped to connect in a well-developed submarginal vein, and also without evident intersecondary veins and sometimes additionally without any evident higher-order venation (e.g., *Pal. acanthacea*, *Pal. mistratoana*, *Pal. shuar*, *Pal. sopkinii*). The species of this new section all lack evident leaf domatia.

The stipules in *Palicourea* sect. *Chocoanae* are laminar (sensu Taylor, 1997a): they have well-developed interpetiolar portions that are free or only very shortly fused intrapetiolarly, although the interpetiolar parts of the stipules are often well developed and wrapped around the stem with their sides overlapping and covering the intrapetiolar portion of the stem. The interpetiolar parts of the stipules in this group are variously shallowly to deeply bilobed, and thin-textured to coriaceous. In most of the species the stipules are very large for *Palicourea*, 20 mm long or longer. *Palicourea*

acanthacea has the largest stipules in the group and some of the largest in the genus, 30–55 mm long. A few species of *Palicourea* sect. *Chocoanae* have stipules that are densely set with distinctive, closely spaced fibers or veins (e.g., *Pal. mistratoana*, *Pal. shuar*); this stipule form is unusual but not unique in *Palicourea*.

Inflorescences. The inflorescences of the species of *Palicourea* sect. *Chocoanae* are terminal but then usually become displaced to a pseudoaxillary position by subsequent growth from a bud in one of the axils below the inflorescence. This arrangement is common in *Palicourea*, but more often the subsequent growth continues from both of the axils so the inflorescence remains clearly terminal. The inflorescences in most species of *Palicourea* sect. *Chocoanae* are sessile to shortly pedunculate and generally erect. However, *Pal. frontinoensis* is unusual in both this group and *Palicourea* overall, with its inflorescences pendulous on very long peduncles (39–106 cm long). Most of the species of this new section have capitate or subcapitate inflorescences that are ovoid, subglobose, or cylindrical, but a few species have regularly developed primary (*Pal. dimorphandrioides*) and sometimes also secondary axes (*Pal. mistratoana*, *Pal. sopkinii*, *Pal. timbiquensis*); when the secondary axes are developed, each usually bears only one subcapitate group of flowers. The flowers of the species in this group are initially subsessile in capitate to subcapitate glomerules or heads, but the axes and pedicels later characteristically elongate as fruits begin to develop. The inflorescences are generally enclosed by well-developed bracts, 5–45 mm long, that are often bright purple or blue; however, *Pal. dimorphandrioides* is unusual in its developed but very narrow bracts, ligulate to triangular and 2–4 × 0.3–1 mm.

Flowers. The flowers in *Palicourea* sect. *Chocoanae* are generally 5-merous (though all Rubiaceae show occasional within-individual variation in merosity), and are documented as distylous in several species; they may be distylous in all of the species, but the floral biology is not yet known for some. The calyx limbs are deeply divided into triangular lobes and vary in size from relatively short in about half of the species, 3 mm long or shorter, to quite well developed, 5–15 mm long. The corollas in this group are slenderly tubular to tubular-funnelform, and white to pale blue or often pink to purple. The corolla tubes are short, 5 mm long or less, in *Pal. cotejensis* and *Pal. shuar* but well developed in all the other species, 10–30 mm long, and relatively quite long in *Pal. deneversii*, ca. 50 mm long. The corolla tube is generally pubescent inside around its middle and sometimes throughout its upper half, rather than having a discrete pubescent ring in the lower portion as in many *Palicourea* species. The corollas in this group have tubes that are longer than the lobes, and the lobes are smooth or only a little thickened on the abaxial surface. The anthers and stigmas of the distylous species are variously partially exserted or fully included, in reciprocal positions in the two floral forms; the flowers seen of the other species agree with either the long-styled or short-styled form of the distylous species in their arrangement, but observation of both forms is needed to confirm that a species is distylous.

Infructescences and fruits. The infructescences in *Palicourea* sect. *Chocoanae* characteristically change shape after flowering, often markedly, as the axes and pedicels elongate and the overall form becomes laxer. This elongation of the axes and pedicels is often not immediately evident, however, because these structures are covered by the bracts. The pedicels of most species of this group are ca. 0.5 mm long in flower and up to 5–10 mm long in fruit. This delayed development of the axes and pedicels is unusual in *Palicourea*, and most other species of this genus have a similar arrangement of the inflorescences and infructescences (though the color of the axes and bracts may change as the fruits develop).

The fruits in *Palicourea* sect. *Chocoanae* are of average size for *Palicourea*, 4–8 × 3–6 mm (measured as dried fruits on herbarium specimens). This contrasts with the relatively large leaves, stipules, inflorescences, and often corollas of many of these species, and differs from the general pattern in *Palicourea* in which robust plants usually have relatively larger fruits. The fruits in *Palicourea* sect. *Chocoanae* are purple-black or occasionally blue at maturity, as in most species of *Palicourea*. These fruits vary in form from ellipsoid to ovoid or obovoid, but are most often rather narrow and a bit flattened laterally. The fruits contain two pyrenes, which are planoconvex and often dorsiventrally flattened rather than hemispherical or laterally compressed as in most *Palicourea* species. Abaxially (dorsally) the pyrenes are occasionally obtusely angled to nearly smooth, but in most species of this group the pyrenes have four or five rounded to usually sharply acute longitudinal ridges. Adaxially (ventrally) the pyrenes are smooth and generally plane, or frequently have a broad, shallow longitudinal furrow. Sometimes the pyrenes also have a longitudinal ridge running down the middle of this adaxial furrow, but the development of a ridge seems to be variable within a species.

The Chocó Biogeographic Region

The Chocó region is regarded here as a phytogeographic area for Rubiaceae that comprises the western slopes of Colombia, from sea level to the top of the western Andean cordillera, and also extends northward into eastern and perhaps central Panama, and south into northwestern Ecuador. This is an area of quite high rainfall with large extents of wet to pluvial forests (Gentry, 1978; Poveda-M. et al., 2004; Rangel-Ch. & Arellano-P., 2004). This region is not well known botanically, with good floristic documentation here mainly in the form of specimen sets from a few scattered sites and much of the area not yet explored botanically. This is an area of high species richness for Rubiaceae (Andersson, 1992), and many Rubiaceae species are only known from this region.

A generalized Chocó phytogeographic or biogeographic region has been referred to by various authors, with varying clarity of delimitation. The region recognized under this name here generally corresponds to the northern portion of the trans-Andean lowland forest of Sedio et al. (2013), also called there the Chocó-Darién region. Sedio et al.'s Chocó-Darién region comprised areas below 1500 m elevation from the eastern or Darién portion of Panama, southward along the Pacific coast of northwestern South America, through western Colombia to southwestern Ecuador, and along the Magdalena River and lower Cauca River valleys. The Chocó Rubiaceae region recognized in this present article includes the northern and central-western portion of this region of Sedio et al. (2013), plus the western slopes of the Andes above 1500 m and up to about 2500 m in Colombia and northwestern Ecuador; however, it excludes the southern coast of Ecuador and the inland river valleys.

This Chocó Rubiaceae region does correspond generally to the Chocó biogeographic region of Rangel-Ch. (2004) and includes the area delimited by him (Rangel-Ch., 2004: map 1) plus adjoining areas of Panama and Ecuador. Although an overall Chocó biogeographic region that extended from Panama to Ecuador was discussed by Rangel-Ch., only the Colombian portion of this region was explicitly delimited and characterized by him. Rangel-Ch.'s Chocó biogeographic region was characterized by its high level of precipitation, from 730 to 13,670 mm per year (Poveda-M. et al., 2004), with most of the region receiving 4000 mm or more of rain per year (Rangel-Ch., 2004: map 3) and without a distinctly dryer season (Rangel-Ch. & Arellano-P., 2004). Similar climatic regimes appear to be found in eastern Panama and northwestern Ecuador, and those areas are similar floristically to the Colombian Chocó, at least for Rubiaceae. Recent botanical exploration also suggests that this Chocó region may extend along the Caribbean coast of Panama to its central-western part, at least for Rubiaceae, with species previously known only from western Colombia and eastern Panama recently documented there (e.g., *Rudgea colombiana* Standl., *Psychotria sanblasensis* C. M. Taylor).

An elevational change in floristic composition in Andean regions has been demonstrated in several analyses (Gentry, 1995; Jørgensen & León-Yánez, 1999), with the flora below 1500 m generally dominated by lowland taxa with Amazonian affinities while the areas above 1500 m have a distinct flora with montane affinities. Andersson (1992, 1995), in his analysis of Neotropical Rubiaceae diversity, located this line of floristic change a bit lower, at 1000 m. His line, however, may correspond to changes in species richness more than separate biogeographic identity. A floristic change or stratification in the Rubiaceae flora is evident throughout southern Central America and the Andes at about 1500 m, except on the Pacific slopes of Colombia and northwestern Ecuador: here the elevational ranges of many Rubiaceae species do not show a stratification at either 1000 or 1500 m. A number of the Rubiaceae species found here in fact range from near sea level to relatively high elevations, e.g., *Palicourea trianae*, 50–1900 m; *Pal. frontinoensis*, 100–1650 m; *Pal. jervisei* (Standl.) C. M. Taylor, 700–2050 m. However, there is a floristic change to a characteristically montane Rubiaceae at a higher elevation, ca. 2500 m. The reason for the distributions of these species down to lower elevations, or perhaps their broader overall elevational ranges, is not known but may be related to the pattern of very high rainfall across all elevations in this region.

Methods

This work is based on standard herbarium techniques. Additional information and tools, including detailed specimen data with distribution maps, phenology charts, and high-resolution scans of representative specimens of most of these species are available online in the TROPICOS® database and its Rubiaceae Project. The species treated here are arranged in alphabetical order. Types were studied variously as physical specimens, as photographs, as high-resolution scans in JSTOR Global Plants (<http://plants.jstor.org>), and as digital photographs provided directly by some herbaria. Bracketed numbers following herbarium codes represent specimen barcode numbers; numbers separated by a hyphen are stamped accession numbers. Morphological terminology follows Lawrence (1951) and Taylor

(1997a). Measurements are based on dried specimens; for this reason fruit measurements here mainly describe pyrene size. Comparative comments about sizes of morphological structures refer only to the group of species studied here. Habitat and distribution are summarized for all the taxa treated here, but phenology is only summarized for the newly described species because only those have been comprehensively detailed. Elevational distributions for the species are given in meters (i.e., above sea level). Detailed provisional conservation assessments are not presented here but are left for better-informed regional conservation assessment teams to analyze. This taxonomy of a group not previously studied supports the World Flora Online. The names *Psychotria* and *Palicourea* are nomenclaturally distinct but similar and commonly confused, therefore the non-standard abbreviations *Psy.* and *Pal.*, respectively, are used in the text here for clarification.

Taxonomic Treatment

Palicourea Aubl. sect. **Chocoanae** C. M. Taylor, sect. nov. TYPE: *Palicourea acanthacea* (Standl. ex Steyerm.) C. M. Taylor.

Diagnosis. This new section can be distinguished from other sections of *Palicourea* Aubl. by the combination of a generally robust habit, well-developed laminar stipules, inflorescences with usually well-developed bracts and flowers subsessile in congested groups or heads, slender corollas that are pubescent inside around the middle, axes and pedicels that elongate as the fruits mature, purple-black or blue fruits, and pyrenes that are usually abaxially ridged.

Shrubs and small trees, frequently robust and with large leaves, stipules, and inflorescences, glabrous to occasionally villosulous, puberulous, or pilosulous; stems quadrangular to weakly flattened, with internodes smooth though sometimes becoming longitudinally channeled when dried. *Leaves* opposite; *blades* generally elliptic to obovate, oblanceolate, or ovate, frequently relatively large (to more than 30 × 18 cm), generally matte; secondary veins developed, usually numerous (frequently more than 20 pairs), usually extending to unite with margins or looping to interconnect in a submarginal vein near margins, sometimes with 1 rather well-developed intersecondary vein and occasionally also 1 or 2 shorter intersecondary veins present between each pair of secondary veins and the reticulated tertiary venation visible abaxially, or sometimes with intersecondary and higher-order venation not visible; *petioles* short to usually well-developed (to 6–8 cm); *stipules* persistent or occasionally deciduous by fragmentation on older nodes (*Palicourea timbiquensis*), laminar (i.e., with intrapetiolar portion reduced), generally well-developed (to 55 mm long, *Pal. acanthacea*), stiff-textured or sometimes membranaceous (*Pal. mistratoana*), internally glabrescent to puberulous or pilosulous, on each interpetiolar side bilobed for 1/3 to 3/4 of their length, lobes deltate to lanceolate, broadly triangular, or ligulate, acuminate to rounded, separated by an acute to concave sinus, entire to ciliolate, often with well-marked subparallel veins or fibers. *Inflorescences* terminal but in most species often quickly displaced to pseudoaxillary, sessile to pedunculate with peduncle sometimes well-developed (to more than 1 m long, *Pal. frontinoensis*), capitate to subcapitate or branched to 1 or 2 orders, variously ovoid, subglobose, cylindrical, or pyramidal in outline, with axes paired or occasionally subverticillate (*Pal. dimorphandrioides*), with secondary axes subtended by 1 bract or infrequently without subtending bract (*Pal. timbiquensis, Pal. plusiantha*), with flowers in heads or cymes of 5 to 15, these heads or cymes enclosed in usually well-developed bracts, these bracts free, ovate to lanceolate, elliptic, oblanceolate, or infrequently linear to pectinate (*Pal. dimorphandrioides*, *Pal. grandistipula*), often relatively large (more than 20 mm long), green to purple, pink, violet, or blue at anthesis. *Flowers* sessile or subsessile, at least sometimes distylous, each subtended by 1 or more floral bracts; hypanthium portion obconic to ellipsoid; *calyx* limb short to frequently well-developed (more than 5 mm), 5-lobed shallowly to deeply (relatively often 4-lobed in *Pal. grandistipula*), lobes generally equal on an individual flower or occasionally unequal by up to 50%; *corolla* tubular to tubular-salverform, variously pink, purple, violet, blue, or white and also sometimes yellow in throat, membranaceous to rather fleshy, internally pubescent in tube near middle and often through upper part, tube small (4–6 mm, *Pal. shuar*) to usually well-developed (more than 15 mm), straight at base or usually swollen and sometimes gibbous there, lobes 5, triangular, abaxially smooth, at tip flat or sometimes cucullate with a prolonged conical apex (e.g., *Pal. shuar*; Fig. 1C); *stamens* inserted in middle or upper part of corolla tube, partially exserted in short-styled form, included and positioned in middle or upper part of corolla tube in long-styled form; *stigmas* bilobed, included and positioned in middle or upper part of corolla tube in short-styled form, exserted in long-styled form. *Infructescences* similar to inflorescences or usually becoming laxer due to elongation of pedicels and sometimes secondary and tertiary axes (e.g., Fig. 1F), apparently similar in color to inflorescences. *Fruits* obovoid to ovoid, lanceoloid, ellipsoid, or narrowly ellipsoid, rather small (4–8 ×

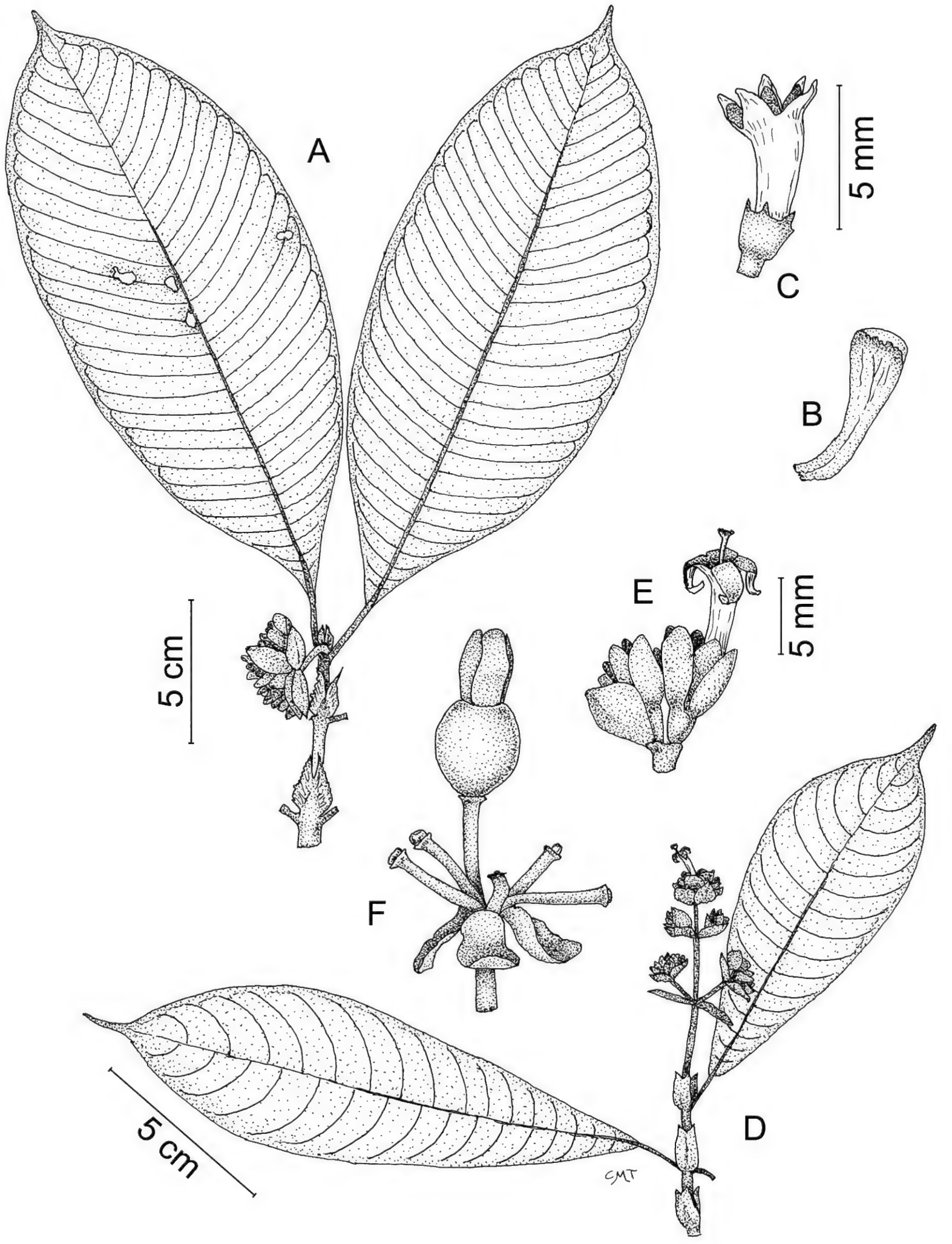

Figure 1. A–C. *Palicourea shuar* C. M. Taylor. —A. Flowering branch. —B. Bract. —C. Flower. D–F. *Palicourea mistratoana* C. M. Taylor. —D. Flowering branch. —E. Portion of inflorescence with one flower at anthesis. —F. Portion of infructescence with one immature fruit and five pedicels from which fruits have fallen. B, C, refer to 5-mm scale bar next to C; E, F, refer to 5-mm scale bar next to E. A, based on *Palacios et al. 15744* (MO); B, C, based on *Croat 58949* (MO); D, E, based on *Fernández et al. 9575* (HUA); F, based on *Fernández et al. 9124* (COL).

2.2–6 mm), blue, purple, or purple-black; *pyrenes* 2, planoconvex and often dorsiventrally weakly flattened, abaxially with 4 to 5 obtuse angles or usually 4 to 5 rounded to acute ridges, adaxially plane with a medial longitudinal furrow or longitudinal ridge.

Palicourea sect. *Chocoanae* includes 14 species found in wet forests at 0–3020 m from eastern Panama to central Ecuador, and also in Andean northern Peru and Andean eastern Colombia and adjacent western Venezuela.

Key to Species of *Palicourea* sect. *Chocoaneae*

1a. Inflorescences pedunculate, with peduncles 39–106 cm long; leaves with blades 24–38 × 11–21 cm; petioles 3.5–7 cm long ..... 5. *Pal. frontinoensis* Cogollo & C. M. Taylor

1b. Inflorescences sessile or pedunculate, when pedunculate then peduncles only up to 8 cm long; leaves with blades 4–50 × 1.5–24 cm; petioles 0.3–11 cm long.

2a. Stipules 30–55 mm long; petioles 6.5–11 cm long; inflorescences capitate or subcapitate, with peduncles 0.4–1 cm long; normally developed leaves with 30 to 44 pairs of secondary veins ..... 1. *Pal. acanthacea* (Standl. ex Steyerm.) C. M. Taylor

2b. Stipules 7–27 mm long; petioles 0.3–8 cm long; inflorescences capitate to branched, sessile or with peduncles up to 8 cm long; normally developed leaves with 10 to 31 pairs of secondary veins.

3a. Leaf blades lacking regularly developed visible intersecondary veins between pairs of secondary veins, with higher-order venation visible or not.

4a. Bracts that subtend flowers or groups of flowers 10–20 mm long ..... 12. *Pal. sopkinii* C. M. Taylor

4b. Bracts that subtend flowers or enclose a group of subsessile flowers 5–8 mm long.

5a. Corollas with tubes ca. 10 mm long and lobes ca. 4.5 mm long; inflorescences pyramidal in outline, with primary axis longer than secondary axes ..... 7. *Pal. mistratoana* C. M. Taylor

5b. Corollas with tubes 4–6 mm long and lobes 1–2.5 mm long; inflorescences ovoid to corymbiform in outline, without developed axes or with secondary axes developed and longer than primary axis ..... 11. *Pal. shuar* C. M. Taylor

3b. Leaves with regularly developed short to long intersecondary veins visible between pairs of secondary veins at least on abaxial surface, and with higher-order venation visible.

6a. Flowers and inflorescences not enclosed by well-developed bracts, bracts present but narrowly triangular to ligulate and 2–4 mm long.

7a. Leaves subsessile, petioles 0.1–0.3 cm long; inflorescences pedunculate, peduncles 8–14 cm long; corolla tubes ca. 50 mm long ..... 3. *Pal. deneversii* (C. M. Taylor) Borhidi

7b. Leaves petiolate, petioles 2–8 cm long; inflorescences subsessile to pedunculate, peduncles when present 0.1–1.5 cm long; corolla tubes ca. 11 mm long ..... 4. *Pal. dimorphandrioides* (Dwyer) C. M. Taylor

6b. Flowers and inflorescences enclosed by well-developed bracts, these bracts triangular to lanceolate, elliptic, or ovate, and 5–40 mm long with at least some bracts more than 6 mm long.

8a. Inflorescences with peduncles 6.5–8 cm long, branched, with a developed primary axis bearing 3 to 5 pairs of distinct flower heads or short secondary axes ..... 14. *Pal. timbiquensis* (Standl.) C. M. Taylor

8b. Inflorescences sessile or with peduncles up to 7 cm long, capitate to subcapitate or branched, with a short to well-developed primary axis, when primary axis developed then flower groups or secondary axes arranged in only 1 or 2 pairs or the entire primary axis covered with overlapping bracts.

9a. Bracts rounded to subtruncate, regularly arranged in decussate pairs ..... 2. *Pal. cotejensis* (Standl.) C. M. Taylor

9b. Bracts acute to obtuse, in irregularly decussate or apparently spiral arrangement.

10a. Leaves with blades 32.5–50 × 12.5–18.5 cm; inflorescences with the largest bracts 35–40 mm long ..... 8. *Pal. orquidea* C. M. Taylor

10b. Leaves with blades 6–30 × 3–15.5 cm; inflorescences with the largest bracts 5–25 mm long.

11a. Inflorescences cylindrical in outline; bracts ovate to obovate, acute to obtuse at tip; calyx lobes 2–2.5 mm long ..... 15. *Pal. trianae* (Standl.) C. M. Taylor

11b. Inflorescences subglobose to ovoid or corymbiform in outline; bracts narrowly triangular to lanceolate or ovate, acute to acuminate at tip; calyx lobes 2–16 mm long.

12a. Calyx lobes 2–5 mm long; plants of the Cordillera Oriental of the Andes in western Venezuela and eastern Colombia.

13a. Leaves with blades 4.8–12 cm wide; stipules 12–25 mm long; largest inflorescence bracts 18–20 mm long ..... 10. *Pal. psilophylla* (Steyerm.) C. M. Taylor

13b. Leaves with blades 3–4.5 cm wide; stipules 8–15 mm long; largest inflorescence bracts 10–15 mm long ..... 13. *Pal. tamaensis* (Standl. & Steyerm.) Steyerm.

12b. Calyx lobes 6.5–16 mm long; plants of the Pacific slopes of the Cordillera Occidental and main cordillera of the Andes, in western Colombia and northwestern Ecuador.

14a. Stipules 14–27 mm long; inflorescences sessile or with peduncles up to 1 cm long; inflorescence bracts 15–25 mm long .... 6. *Pal. grandistipula* (Standl. ex Steyerm.) C. M. Taylor
14b. Stipules 7–10 mm long; inflorescences with peduncles 1.5–2.7 cm long; inflorescence bracts 5–17 mm long..... ..... 9. *Pal. plusiantha* (Standl.) C. M. Taylor

1. Palicourea acanthacea (Standl. ex Steyerm.) C. M. Taylor, Novon 6(2): 211. 1996. Basionym: *Cephaelis acanthacea* Standl. ex Steyerm., Acta Biol. Venez. 4(1): 8, figs. 4, 5. 1964. TYPE: Colombia. Valle del Cauca: Río Calima (región del Chocó), La Trojita, 5–80 m, 19 Feb.–10 Mar. 1944, *J. Cuatrecasas 16572* (holotype, mounted on two sheets: F-1153741! and F-1153742!; isotype, F-1153740!).

Habitat and distribution. This species is known from wet forest, generally at 0–500 m and occasionally up to 1330 m, in western Colombia and northwestern to central-western Ecuador.

Notes. *Palicourea acanthacea* can be recognized by its robust habit, with large petiolate leaves and stipules, along with its subsessile, subcapitate, pyramidal inflorescences with well-developed red-purple bracts; its rather well-developed calyx limbs; its slender, well-developed purple corollas; and its rather small blue fruits. It is generally locally common and forms large stands in sunny secondary growth (C. M. Taylor, pers. obs.).

Palicourea acanthacea is similar to *Pal. orquidea*, which is also found in western Colombia but at somewhat higher elevations and north of the range of *Pal. acanthacea*. *Palicourea orquidea* can be separated by its oblanceolate leaves that are acute to tapered at the base and its shorter petioles, 2–6 cm long, versus elliptic leaves that are obtuse to rounded at the base and petioles 6.5–11 cm long in *Pal. acanthacea*. *Palicourea acanthacea* is also similar to *Pal. frontinoensis*; for comments about their separation see the notes for *Pal. frontinoensis*, below.

The nomenclature and typification of this name have been somewhat complicated. *Palicourea acanthacea* was intended to be a replacement name based on *Cephaelis acanthacea*, because the name *C. acanthacea* was considered an invalid name at that time due to the rules then in effect regarding typification. The authorship of the name *Pal. acanthacea* was originally incorrectly attributed to "Standl. ex Steyerm. ex C. M. Taylor," as an attempt to validate a name that had been credited to "Standl. ex Steyerm." (Taylor, 1996b), but this citation is incorrect because neither Standley nor Steyermark actually proposed a name for this species in *Palicourea*. The validity of the typification and thus publication of the first name for this species, *C. acanthacea*, has changed over the last 25 years due to changes in the Code of Nomenclature; this name is currently validly published but was invalid during 1994–2000 under the Tokyo Code (Greuter et al., 1994) because of the designation of its holotype. In the protologue, Steyermark cited both a holotype and an isotype deposited at F, and he annotated three corresponding sheets at F of the type collection: one sheet with only a leaf he annotated as an isotype (F-1153740), and two other sheets were explicitly annotated by him on his personal determination slips and illustrated (Steyermark, 1964: figs. 4, 5) as the holotype of *C. acanthacea* (F-1153741 and F-1153742). These two sheets are also clearly labeled as two parts of one holotype, with the annotations by Steyermark "Holotype (1 of 2)" and "Holotype (2 of 2)." These two holotype sheets are each incomplete, with a stem and inflorescence on one sheet and only a leaf on the other. Steyermark thus clearly regarded these sheets as one specimen mounted in two parts, and both parts together as the holotype following what was then current practice. However, the rules regarding typification were substantially changed from previous practice in the Tokyo Code, where Article 8.1 specified that the holotype must be "a single specimen" (Greuter et al., 1994). The intent and application of this rule were clarified by the Nomenclature Committee at the time that a single specimen was one preparation or sheet out of what may be a larger set, so that in the case of large vascular plants a single specimen was one herbarium sheet even if that sheet was incomplete (F. Barrie, pers. comm., 1995). The Tokyo Code was thus applied to retroactively invalidate a number of names that were based on holotypes mounted on more than one herbarium sheet, including *C. acanthacea*, that did not have a designated holotype under these rules. Accordingly, a number of names with multi-part holotypes that had previously been considered valid were republished during this period, to make them valid under the new rules (e.g., Taylor, 1996b). Subsequently, the Code was changed to reverse this Tokyo Code rule, due to the confusion generated and the problems posed for adequate typification of large plants such as palms. The later republications of these names are therefore superfluous, though in some cases (not including any species of this group) the later-designated single-sheet type is now treated as a lectotype. The St. Louis Code (Greuter et al.,

2000) retained the wording of Article 8.1 but clarified in the newly added Articles 8.2–8.3 that a single specimen could be mounted on more than one herbarium sheet as long as the individual parts "are clearly labelled as being part of that same specimen." Because the individual parts of the holotype of *C. acanthacea* were clearly labeled as such, Steyermark's original typification of this name is allowed and its again-valid status is affirmed in Article 8 Ex. 4 (Greuter et al., 2000; McNeill et al., 2012; although the published lectotypification of this name is not mentioned in this example, and the status of the other lectotypifications done under the Tokyo Code was not specifically addressed in this or subsequent Codes). Therefore, although *Pal. acanthacea* was a newly described species based on the description of an invalid name when this name was published (Taylor, 1996b), it is now a combination based on the valid basionym *C. acanthacea*.

2. **Palicourea cotejensis** (Standl.) C. M. Taylor, comb. nov. Basionym: *Cephaelis cotejensis* Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 11(5): 187. 1936. *Psychotria cotejensis* (Standl.) J. H. Kirkbr., Acta Amazon. 10: 100. 1980. TYPE: Colombia. Cauca: Coteje on Río Timbiquí, 0–300 m, Nov. 1898, *F. C. Lehmann 9022* (holotype, B†; lectotype, designated by Kirkbride [1980: 100], K [K000432879] image!, K [K000432879]! as photo in MO-2782279; isolectotype, F-654186 image!).

Habitat and distribution. This species is known from wet forest at 0–300 m in central western Colombia.

Notes. *Palicourea cotejensis* has not been commonly collected, but it is distinctive in the combination of its robust habit, its oblanceolate or obovate firm-textured leaves with short petioles and numerous secondary veins (19 to 23 pairs), and its purple inflorescences that are subsessile and flattened-cylindrical with the rounded bracts in four superposed series and regularly imbricated. The suborbicular outer bracts are 20–25 mm long and enclose short cymes of smaller bracts and flowers. Kirkbride (1980: 100–103, figs. 4, 8) presented a description of this species and a photograph of its lectotype. *Palicourea cotejensis* was known for a long time only from three collections made between 1898 and 1946 (Kirkbride, 1980), but has recently been rediscovered in the same region by W. Vargas (pers. comm.).

As noted by Kirkbride (1980: 103), *Palicourea cotejensis* is similar to and commonly confused with the more commonly collected species *Pal. trianae*, which is found in the same region. *Palicourea trianae* can be separated by its rounded-cylindrical inflorescences with the bracts apparently arranged spirally, and its leaves with fewer secondary veins (14 to 18 pairs).

3. **Palicourea deneversii** (C. M. Taylor) Borhidi, Acta Bot. Hung. 59: 16. 2017. Basionym: *Psychotria deneversii* C. M. Taylor, Novon 6: 301, fig. 2C, D. 1996. TYPE: Panama. San Blas: El Llano–Cartí rd., 18 km from Interamerican Hwy., 9°19′N, 78°55′W, 300 m, 7 Sep. 1984, *G. de Nevers 3861* (holotype, PMA-38224 image!; isotype, MO-4658111!).

Habitat and distribution. This species is found in wet forest at 300–400 m in eastern Panama.

Notes. *Palicourea deneversii* is a distinctive species with an apparently narrow range that has been infrequently collected. It can be recognized by the combination of its robust habit; its rather large subsessile, obovate leaves; its distinctive cylindrical, pedunculate, densely cymose inflorescences; and its rather large, white corollas with the slender tubes ca. 50 mm long. The unusual inflorescences appear subcapitate at first glance, but the axes are shortly developed. The bracts are generally not evident among the relatively long buds of the corollas. *Palicourea deneversii* is similar to *Pal. dimorphandrioides*, which can be separated by its petiolate leaves, subsessile inflorescences, and flowers with shorter corolla tubes ca. 11 mm long.

4. **Palicourea dimorphandrioides** (Dwyer) C. M. Taylor, Novon 6(2): 211. 1996. Basionym: *Cephaelis dimorphandrioides* Dwyer, Ann. Missouri Bot. Gard. 67(1): 66. 1980. TYPE: Panama. Veraguas: valley of Río Dos Bocas betw. Alto Piedra & Calovébora, 350–400 m, 19 Aug. 1974, *T. B. Croat 27470* (holotype, MO-2201358!).

Habitat and distribution. This species is found in wet forest at 400–1800 m from central Panama to northwestern Colombia.

Notes. *Palicourea dimorphandrioides* is a distinctive species that has been only occasionally collected. It can be recognized by the combination of its robust habit, its rather large obovate leaves, its distinctive cylindrical, shortly pedunculate to subsessile, densely cymose inflorescences with numerous narrow bracts, and its white to yellow tubular-

funnelform corollas with the tubes ca. 11 mm long. The unusual inflorescences appear subcapitate at first glance, but the pedicels and axes are shortly developed. These are mixed with many narrowly triangular to ligulate purple bracts, the outer or largest of which are 2–4 mm long. These bracts are similar to the narrow calyx lobes, which are 5–8 mm long. The form of the inflorescences, with the axes densely congested and the numerous very narrow bracts and calyx lobes, is unique in *Palicourea*. In overall aspect, *Pal. dimorphandrioides* is similar to *Pal. trianae*; *Pal. trianae* can be separated by its inflorescences enclosed in ovate to obovate bracts 15–20 mm long. *Palicourea dimorphandrioides* is also similar to *Pal. deneversii*, which can be separated by its subsessile leaves, pedunculate inflorescences, and longer corolla tubes ca. 50 mm long.

5. Palicourea frontinoensis Cogollo & C. M. Taylor, Caldasia 19: 91, fig. 1. 1997. TYPE: Colombia. Antioquia: Parque Nacional Natural "Las Orquideas," margen derecha del Río Venados, 6°35′N, 76°17′W, 1650 m, 15 Feb. 1989, *A. Cogollo, D. Cárdenas, R. Ramírez & O. Alvarez 4021* (holotype, JAUM-018098!).

Habitat and distribution. This species is found in wet forest at 100–1650 m in northwestern Colombia and northwestern Ecuador.

Notes. *Palicourea frontinoensis* is a distinctive species characterized by its robust habit; its relatively large leaves and stipules; its subcapitate to congested-cymose inflorescences that are pendulous on remarkably long peduncles, 39–106 cm long; and its relatively large purple bracts, with the outermost 10–35 mm long. When this species was discovered it was thought to be localized in wet premontane forests in northwestern Colombia (Cogollo-P. & Taylor, 1997), but it has subsequently been documented also from northwestern Ecuador. *Palicourea frontinoensis* may thus be expected in similar habitats that lie between these sites; the Cordillera Occidental of the Andes is not well explored, and the extremely wet forests where this species grows are particularly poorly known.

Although *Palicourea frontinoensis* is unusual in Neotropical Rubiaceae, it is remarkably similar in both vegetative and inflorescence form to several species of *Psychotria* from central and eastern Africa. These species were separated at one time in *Camptopus* Hook. f., a genus distinguished by its subcapitate inflorescences with the outer bracts 15–30 mm long and its unusually well-developed peduncles, 12–180 cm long. These species are now classified in *Psychotria* (Petit, 1964; Razafimandimbison et al., 2014) and include *Psy. megalopus* Verdc. and *Psy. camptopus* Verdc. In these species the peduncle holds the pendulous inflorescences in the air but later elongates to position the infructescences near or on the ground (Verdcourt, 1976: 77; C. M. Taylor, pers. obs.), perhaps to facilitate fruit dispersal by ground-dwelling animals. In contrast, the long peduncles of *Pal. frontinoensis* suspend the inflorescences and infructescences well above the ground and to the side of and below the plant's stems, apparently to facilitate access by hummingbirds to the flowers and perhaps by other birds to the fruits. *Palicourea frontinoensis* is also similar to *Pal. acanthacea*, which is also found in western Colombia; *Pal. acanthacea* can be separated by its erect, subsessile or only shortly pedunculate inflorescences that are positioned above the leaves and stems of the plant.

In the protologue of *Palicourea frontinoensis*, an isotype was cited as deposited at MO, but this was an error.

6. Palicourea grandistipula (Standl. ex Steyerm.) C. M. Taylor, Novon 6(2): 211. 1996. Basionym: *Cephaelis grandistipula* Standl. ex Steyerm., Acta Biol. Venez. 4: 19, fig. 9. 1964. TYPE: Colombia. Valle del Cauca: costa del Pacífico, Bahia de Buenaventura, Quebrada Aguadulce, 0–10 m, 11 Nov. 1945, *J. Cuatrecasas 19750* (holotype, F-1285268!; isotype, US-1564328!).

Cephaelis spectabilis Standl. ex Steyerm., Acta Biol. Venez. 4(1): 21–22. 1964. TYPE: Colombia. Valle del Cauca: costa del Pacífico, Río Yurumanqui, Veneral, 5–50 m, 28 Jan.–10 Feb. 1944, *J. Cuatrecasas 15734* (lectotype, designated here, F-1149915 image!; isolectotypes, F-1149924 image!, F-1149926 image!, US-2772254 image!, US-2272255 image!, US-2272256 image!).

Habitat and distribution. This species is found in wet forest at 0–1150 m in western Colombia and northwestern Ecuador.

Notes. *Palicourea grandistipula* is characterized by the combination of its robust habit; its relatively large leaves and stipules; and its subsessile to shortly pedunculate, subglobose, subcapitate inflorescences with well-developed, narrowly triangular bracts. The inflorescences are apparently pale green to whitened or flushed with blue, and the corollas are also white or flushed with blue. The calyx lobes are narrowly triangular and rather well developed, 6–7.5 mm long, and similar in form to the bracts but about half as long. As the fruits mature, the inflorescence axes and pedicels usually elongate, sometimes enough so that

the developing fruits are positioned outside the bracts that previously enclosed the flowers (e.g., *Ferro-Muñoz 12*, MO).

The inflorescence arrangement of *Palicourea grandistipula* is similar to that of *Pal. dimorphandrioides*, and these species are similar in general aspect and possibly sympatric; however, *Pal. grandistipula* has much larger bracts. *Palicourea grandistipula* is also similar to *Pal. amplissima* (Standl. ex Steyerm.) C. M. Taylor, which is found in the same region; *Pal. amplissima* can be separated by its inflorescences with the bracts that subtend flowers and flower groups ovate to suborbicular with obtuse to rounded apices, and its rounded calyx lobes, 1.5–2 mm long.

The names *Cephaelis grandistipula* and *C. spectabilis* were distinguished by Steyermark initially by number of corolla lobes, width of the pubescent ring inside the corolla, and position of the anthers. However, the number of corolla lobes (four vs. five, respectively) sometimes varies within species and even on individual plants of *Palicourea*, and *Pal. grandistipula* has both 4-lobed and 5-lobed corollas, with this number not consistent on an individual plant. The distribution of the internal corolla pubescence can also vary within a species, as well as between morphs of distylous species and with developmental stage, so it is not a reliable difference to separate these species. And, the differences in anther position he described (Steyermark, 1964: 17–19) actually correspond to the different positions found in long-styled versus short-styled flowers of a single species. Steyermark also described these two species as having different leaf sizes, but continuous variation in leaf size is now documented that links these different measurements. Therefore, these two names apply to the same species and were synonymized by Taylor (1996b).

The holotype of the name *Cephaelis spectabilis* was designated in the protologue only as *Cuatrecasas 15734* deposited at F, and this specimen was not illustrated there (Steyermark, 1964). Three sheets of *Cuatrecasas 15734* are deposited at F, and all three have the name "Cephaelis spectabilis Standl." typed on their labels and none of them were annotated by Steyermark. Standley's proposed name was formally published by Steyermark, based on Standley's unpublished work (Steyermark, 1964: 1–2) and study of Cuatrecasas's specimens from various institutions; the holotypes of these names were designated at F whenever a duplicate was deposited at that institution, which was Standley's home institution, but many were never annotated by Steyermark. After this name was published, the three sheets of *Cuatrecasas 15734* at F were then annotated as "Type or Isotype of *Cephaelis spectabilis* Standl. ex Steyerm." in 1966 by Darelyn Weber, a local botanist and perhaps Field Museum staff member; at that time, "Type" was often used to mean the holotype. None of these sheets were numbered or otherwise noted to be part of a set before or in her annotations. These sheets were first annotated as three parts of a set about a decade later by Donald Simpson, who studied Rubiaceae at the Field Museum in the mid-1970s. Simpson also annotated one of these sheets as the holotype and the other two as isotypes, but never published these designations. As noted in the discussion above of *Palicourea acanthacea*, the Code of Nomenclature now specifies that a holotype specimen comprises either one mounted sheet or a set of individual parts or sheets that are clearly labeled as part of the same specimen, and if the individual sheets are not clearly labeled as part of a set then they are to be treated as duplicates (McNeill et al., 2012: Art. 8.3). The Code does not specify when the parts must be labeled, but the implication is that the parts of the holotype must be deliberately labeled as such and the holotype recognized to comprise all of them by the name's author, and all the cited examples in Article 8 show this situation (and the alternate interpretation would retroactively change the typification of a number of names from the author's stated intent to an automatic typification outside of the author's control, which seems directly counter to the overall intent of Articles 8 and 9.1; see also the discussion of *Pal. sopkinii*, below). Because the specimens of *Cuatrecasas 15734* deposited at F were not annotated at all by Steyermark and not recognized to form a set until after this name was published, they do not fit the specifications of Article 8.3 for deliberate designation of numbered parts as a holotype specimen. Accordingly, the *Cuatrecasas 15734* specimens at F are here regarded as duplicates and therefore syntypes, and this name is here lectotypified. Two of the sheets at F of *Cuatrecasas 15734* are complete, with a stem with leaves, stipules, and an infructescence, and each of these is adequate to fix the identity of this name, while the third sheet is vegetative and not adequate on its own. The complete sheet with the better-developed infructescence and the F accession number 1149915 is here designated as the lectotype.

7. Palicourea mistratoana C. M. Taylor, sp. nov. TYPE: Colombia. Risaralda: Mpio. Mistrató, entre corregimientos Geguadas y Puerto de Oro, 1550 m, 29 Mar. 1992, *J. L. Fernández A., J. Betancur, O. Rangel, I. Rentería & J. M. Guzmán 9575* (holotype, HUA-092531!; isotypes, COL n.v., MO-04644117!). Figure 1D–F.

Diagnosis. *Palicourea mistratoana* C. M. Taylor is distinguished from *Pal. sopkinii* C. M. Taylor by its smaller, whitened or pale green to bluish green bracts, and from *Pal. shuar* C. M. Taylor by its larger habit, smaller leaves, and smaller bracts.

Small trees flowering at 3 m tall, to 4 m tall; stems glabrous, quadrangular to weakly flattened. *Leaves* opposite; *blades* oblanceolate, 11.5–21 × 3–6.2 cm, at base acute to obtuse, at apex tapered then acuminate with tips 10–25 mm, drying papery, adaxially glabrous, abaxially on costa and secondary veins densely puberulous to strigillose or pilosulous and on lamina glabrous markedly paler; margins thinly cartilaginous; secondary veins 19 to 27 pairs, extending to near margins and weakly looping to connect there or weakly extending to unite with margins, without domatia, without evident intersecondary veins, adaxially costa prominulous, secondary veins plane to thickened, and remaining venation plane, abaxially costa prominent, secondary veins prominulous, and remaining venation plane; *petioles* 1–2 cm, glabrous; *stipules* persistent, laminar, glabrous, ovate to elliptic in outline, 11–15 mm, emarginate or bilobed for up to 1/3 their length, with closely set parallel fibers or veins, lobes obtuse to rounded, with margins entire to shortly erose. *Inflorescences* terminal, paniculiform, pilosulous to glabrescent, pale green to whitened or bluish green, pedunculate; peduncles ca. 2 cm; branched portion pyramidal, 3–4 × 4–6 cm, branched to 2 orders, with 1 to 2 pairs of secondary axes; bracts elliptic to oblanceolate or suborbicular, glabrous, obtuse to rounded, those subtending secondary axes 10–20 mm and often cucullate, those subtending flowers 5–8 mm. *Flowers* subsessile in groups of 5 to 11, whether distylous or homostylous unknown; hypanthium obconic, 2–2.5 mm, glabrous; *calyx limb* ca. 5 mm, glabrous, divided to base, lobes 5, elliptic, obtuse to rounded, imbricated; *corolla* funnelform, white, externally glabrous, tube ca. 10 mm, ca. 2 mm diam. near middle, weakly swollen at base and weakly curved along its length, internally not seen, lobes 5, narrowly triangular, ca. 4.5 mm, at tips plane, abaxially smooth; *anthers* and *stigmas* not seen. *Infructescences* similar to inflorescences except often with axes more widely spreading and pedicels to 3 mm; immature *fruits* ellipsoid to subglobose, ca. 5 × 4.5 mm, glabrous, mature color not noted; fully formed *pyrenes* not seen.

Phenology. *Palicourea mistratoana* has been collected in flower in March and with fruits in April.

Habitat and distribution. This species is found in wet forest at 1500–1550 m in the Cordillera Occidental of western Colombia.

Notes. *Palicourea mistratoana* is characterized by its rather well-developed, emarginate to bilobed, laminar stipules, its medium-sized oblanceolate leaves with rather numerous secondary veins but without evident intersecondary veins, its pyramidal branched inflorescences with rather well-developed pale green to whitened or bluish green bracts, and its rather small flowers. The lamina surfaces on the undersides of the leaf blades (i.e., between the veins) have unusually large epidermal cells and probably are pale or perhaps shiny in life. As in other species of *Palicourea* sect. *Chocoanae*, the flowers are initially arranged in subsessile heads and then become separated on axes and pedicels that elongate as the fruits mature. The calyx limb is deeply divided into quite broad lobes for *Palicourea*, which are unusual in their imbricated rather than side-by-side arrangement. *Palicourea mistratoana* is known by only a few collections from the area of Mistrató in western Colombia, and the species epithet refers to this locality.

Palicourea mistratoana is similar to *Pal. sopkinii*; *Pal. sopkinii* can be separated by its flowers that are subtended by larger bracts, 15–20 mm long. *Palicourea mistratoana* is also similar to *Pal. shuar*, described below; *Pal. shuar* can be separated by its generally smaller habit, with the plants up to about 1.5 m tall and little-branched, its larger leaves, and its deflexed corymbiform inflorescences with larger bracts.

Paratypes. COLOMBIA. **Risaralda:** Mpio. Mistrató, correg. Jeguadas, *J. Betancur, J. L. Fernández, O. Rangel, I. Rentería & J. M. Guzmán 3145* (COL); correg. Puerto de Oro, vía Pisones-Geguadas, *J. Betancur, J. L. Fernández, O. Rangel, I. Rentería & J. M. Guzmán 3145* (COL); entre corregimientos Geguadas y Puerto de Oro, *J. L. Fernández A., J. Betancur, O. Rangel, I. Rentería & J. M. Guzmán 9619* (COL, MO).

8. Palicourea orquidea C. M. Taylor, Novon 7(2): 191, fig. 1A, B. 1997. TYPE: Colombia. Antioquia: Mpio. de Urrao, Parque Las Orquideas, camino de Calles hacia Venados arriba, sector Bellavista, 1685 m, 6°30′N, 76°20′W, 7 July 1991, *A. Cogollo P., C. Builes & O. Álvarez 5026* (holotype, MO-4281229!; isotype, JAUM!).

Habitat and distribution. This species is found in very wet forest at 1300–1650 m in northwestern Colombia.

Notes. *Palicourea orquidea* is a robust species characterized by the combination of its obovate leaves with quite large blades (32.5–50 × 12.5–18.5 cm) on short petioles; its rather large stipules; its subsessile,

subcapitate, pyramidal inflorescences enclosed by red-purple bracts 35–40 mm long; and its rather short calyx limbs, 2.5–3 mm long. The flowers are borne in small, congested cymes, which are enclosed by the well-developed ovate inflorescence bracts. The entire inflorescence is dense and perhaps mucilaginous in life, and flowers of *Pal. orquidea* have been collected but their corollas are not well enough preserved on the dried specimens to describe in detail or measure. *Palicourea orquidea* has been collected only a few times at the northern end of the western Andes in Colombia.

Palicourea orquidea is similar in particular to *Pal. acanthacea*; for comments on their separation, see the discussion of *Pal. acanthacea* above.

9. Palicourea plusiantha (Standl.) C. M. Taylor, comb. nov. Basionym: *Psychotria plusiantha* Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 11(5): 246. 1936. TYPE: Colombia. Provincias de Chocó y Barbacoas, 100 m, 1851–1857, *J. J. Triana 1711* (holotype, P [P00837144] image!; isotype, F-638371 image!).

Small trees flowering at 4 m tall, to 4.5 m tall; stems quadrangular, rather fleshy, glabrous to puberulous or strigillose. *Leaves* opposite; *blades* obovate to elliptic, 16–24.5 × 6–12 cm, at base acute, at apex acuminate with tips 6–15 mm, drying papyraceous, adaxially glabrous or puberulous to strigillose on costa to throughout, abaxially puberulous to strigillose on veins to throughout and often pale; margins puberulous; secondary veins 14 to 25 pairs, extending to weakly connect with margins or looping to interconnect with each other near margins, with 1 reticulated intersecondary vein present between each pair of intersecondary veins, without domatia, adaxially costa prominulous and remaining venation plane to thickened, abaxially costa prominent and secondary, intersecondary, and reticulated tertiary venation thickened to prominulous; *petioles* 1.5–5 cm, strigillose or puberulous to glabrous; *stipules* persistent, shortly united around stem to laminar, ovate, 7–10 mm, abaxially densely strigillose, lobed for 1/4 to 1/3 their length, lobes deltate, obtuse to acute, marginally ciliolate. *Inflorescences* terminal, subcapitate to paniculiform, pedunculate, densely strigillose, green; peduncle 1.5–2.7 cm; branched portion corymbiform, 3–6 × 5–7 cm, branched to 1 to 3 orders, with 1 to 2 pairs of secondary axes; bracts lanceolate to ligulate, densely strigillose, acute, marginally ciliolate and sometimes also shortly erose, those subtending secondary axes 12–17 mm or sometimes lacking, those subtending flowers 5–10 mm. *Flowers* subsessile, borne in subcapitate to shortly dichasial groups of 5 to 15, whether homostylous or distylous unknown; hypanthium 1–1.2 mm, obconic, glabrescent; *calyx limb* 8–10 mm, glabrescent, lobed nearly to base, lobes 5, narrowly ligulate, acute, entire; *corolla* salverform to slenderly funnelform, white, externally puberulous to strigillose, tube ca. 20 mm, ca. 1.5 mm diam. near middle, with basal portion not seen, generally straight along tube, internally not seen, lobes 5, ligulate, 4–5 mm, acute, apparently smooth abaxially and plane at tips; *anthers* ca. 3 mm and exserted; *stigmas* not seen. *Infructescences* similar to inflorescences except with axes and pedicels more developed, pedicels to 7 mm. *Fruits* obovoid, ca. 6 × 4 mm, laterally weakly flattened, mature color unknown; *pyrenes* 2, hemispherical, abaxially with 4 to 5 sharp longitudinal ridges, adaxially plane with a shallow median groove.

Habitat and distribution. This species is found in wet forest at 100–1550 m in western Colombia and northwestern Ecuador.

Notes. Palicourea plusiantha has been infrequently collected, and was described based only on plants with young inflorescences and flowers all in bud and thus has been poorly known. Recently this species has been documented by new collections; therefore, an updated description is presented here. The number of mature flowers available for study is still very few, and these are not entirely well prepared and have not been dissected in order to preserve them. *Palicourea plusiantha* is characterized by its somewhat robust leaves; its rather well-developed stipules; its pedunculate, subcapitate to shortly cymose inflorescences with well-developed bracts; its well-developed calyx limbs with narrow lobes; its rather well-developed slender white corollas; and its obovoid fruits with pyrenes that have rather sharp longitudinal ridges.

Palicourea plusiantha is similar to *Pal. grandistipula*; *Pal. grandistipula* can be recognized by its larger stipules (12–35 mm long) and its sessile or only shortly pedunculate inflorescences, with the peduncles 1 cm long or shorter. *Palicourea plusiantha* is also similar to *Pal. seemannii* Standl.; *Pal. seemannii* can be recognized by its branched inflorescences with shorter bracts, 0.5–9 mm long; its flowers that are mostly or all pedicellate in bud and at anthesis; its shorter calyx limbs, 1.5–3 mm long; and its shorter blue corollas (with tubes 12–15 mm long) that are markedly gibbous and bent 45° or more at the base.

The specimen *Triana 1711* deposited at F is clearly an isotype, because it comprises pieces taken from the P holotype (McNeill et al., 2012; Art. 8 Ex.

5). The F specimen comprises a few small pieces of a leaf and one small part of an inflorescence, which clarify several characters of this species but are not adequate alone to clarify the identity of this name. The specimen *Triana 1171* deposited at E (barcode E00085653) lacks label data beyond the collector and number; it may be an isotype, but the labeling of Triana's materials is complex (Kirkbride, 1982) and this specimen could be part of a different gathering. See the notes for *Pal. trianae*, below, for more comments about Triana's materials.

Additional specimen studied. ECUADOR. **Esmeraldas:** cantón San Lorenzo, rd. Lorenzo–Ibarra, ca. 15 km NW of Lita, 0°58′11.5″N, 78°34′16.8″W, 600 m, 13 May 2014, *C. Persson & J. Rova 1883* (MO).

10. Palicourea psilophylla (Steyerm.) C. M. Taylor, stat. et comb. nov. Basionym: *Palicourea tamaensis* var. *psilophylla* Steyerm., Acta Bot. Venez. 6: 153. 1971. TYPE: Venezuela. Táchira: cabeceras del río Quinimarí, faldas y peñascos de El Banca, debajo del Cerro Las Copas (debajo del páramo del Judío), 20 km al S de San Vicente de la Revancha, 35 km al S de Alquitrana, SO de Santa Ana, 2500–2700 m, 15 Jan. 1968, *J. A. Steyermark, G. Dunsterville & E. Dunsterville 100940* (holotype, VEN-78695 image!; isotypes, NY [NY00115265] image!, U [U0006117] image!).

Habitat and distribution. This species is found in wet forest at 2360–2700 m in the Cordillera Oriental of the Andes, in western Venezuela and adjacent eastern Colombia.

Notes. *Palicourea psilophylla* was originally regarded as conspecific with *Pal. tamaensis*, but these are here separated as two sympatric species. They share several distinctive features, in particular well-developed laminar stipules that are divided for about two thirds of their length into ovate lobes, well-developed petioles, ovate leaf blades with ciliolate margins and a short intersecondary vein between each pair of secondary veins, and subsesssile subcapitate purple inflorescences with well-developed lanceolate bracts that are marginally ciliate. Steyermark (1971) studied *Pal. tamaensis* in detail and separated two varieties based only on pubescence characters: the petioles strigillose and the leaves hirtellous adaxially and hispidulous on the veins abaxially in *Pal. tamaensis* var. *tamaensis*, versus the petioles and leaves glabrous or glabrescent in *Pal. tamaensis* var. *psilophylla* Steyerm. He noted that the form of the leaf blade varied similarly, from obtuse to subtruncate at the base, in each variety. Steyermark cited three specimens of *Pal. tamaensis* var. *tamaensis* from Venezuela and Colombia, and one specimen of *Pal. tamaensis* var. *psilophylla* from Venezuela. Additional specimens are now available of both of his varieties, and although *Pal. tamaensis* var. *psilophylla* is still poorly documented, it does appear to be a distinct species and is treated as such here. *Palicourea psilophylla* can be recognized by its leaf blades 4.8–12 cm wide, its stipules 12–25 mm long, its outer inflorescence bracts 18–20 mm long, and the blackened drying color of its herbarium specimens, in contrast to leaf blades 3–4.5 cm wide, stipules 8–15 mm long, outer inflorescence bracts 8–15 mm long, and a green or brownish green drying color in *Pal. tamaensis*. However, the pubescence characters noted by Steyermark do not separate these species: plants of *Pal. tamaensis* sometimes have glabrous petioles and leaves (*Uribe U. 1085*, MO), while plants of *Pal. psilophylla* sometimes have hispidulous or hirtellous leaves (*Gentry et al. 71832*, MO). The material seen of *Pal. psilophylla* is not yet adequate to document details of the flowers and fruits, so more study will be needed to understand this species.

Additional specimen studied. COLOMBIA. **Cundinamarca:** Carpanta, sector Siete Cuerales, 20 km due S of Junin, 4°35′N, 73°40′W, *A. Gentry, A. Repizzo & C. Solano 71832* (MO).

11. Palicourea shuar C. M. Taylor, sp. nov. TYPE: Ecuador. Pastaza: along rd. from Puyo to Macas, ca. 33 km S of Puyo, 24.9 km S of Veracruz, 16 km S of Escuela Fiscal Cotopaxi, 1°38′S, 77°52′W, ca. 900 m, 3 May 1984, *T. B. Croat 58949* (holotype, MO-6357500!; isotype, QCNE n.v.). Figure 1A–C.

Diagnosis. *Palicourea shuar* C. M. Taylor is distinguished from other species of *Palicourea* Aubl. sect. *Chocoanae* C. M. Taylor by the combination of its low, little-branched habit, well-developed bilobed laminar stipules 16–27 mm, somewhat large leaves (14.5–24 cm) with numerous secondary veins that are united in a submarginal vein but lack evident intersecondary veins, shortly pedunculate deflexed inflorescences that are subcapitate to shortly branched and rounded-corymbiform in outline, and rather well-developed bracts, those subtending flowers 5–7 mm.

Subshrubs or shrubs flowering at 1 m tall, to perhaps 1.5 m tall (*Croat 58949*: "more than 1 m tall"), apparently little-branched and somewhat fleshy; stems glabrous, quadrangular. *Leaves* opposite; *blades* elliptic to elliptic-oblong or obovate-oblong, 14.5–24 × 6–13 cm, at base acute to obtuse, at apex obtuse to rounded then abruptly acuminate

with tips 2–10 mm, drying papyraceous, adaxially glabrous, abaxially densely puberulous to hirtellous on costa and secondary veins and on lamina sparsely hirtellous to glabrous and whitened; margins somewhat thickly cartilaginous; secondary veins 24 to 31 pairs, looping to interconnect near margins or extending weakly to unite with margins, without domatia, without evident intersecondary veins, adaxially costa plane to prominulous and remaining venation plane, abaxially costa prominent, secondary veins prominulous, and remaining venation plane and not visible; *petioles* 1.5–4 cm, glabrous; *stipules* persistent, laminar or very shortly united around stem, glabrous to hirtellous, bilobed, with basal unlobed interpetiolar portion 5–10 mm, with sinus between lobes rounded to acute, with lobes asymmetrically triangular or asymmetrically lanceolate, 11–18 mm, with central margins straight and petiole-side margins rounded, at apex acute to acuminate, with closely set parallel fibers or veins, marginally entire to erose. *Inflorescences* terminal, subcapitate to shortly cymose, deflexed, glabrous, white to pink or purple, pedunculate; peduncles 1–2.5 cm; flowering portion rounded-corymbiform, 2–4 × 3–6 cm, branched for 1 to 2 orders, without developed secondary axes or with 1 pair; bracts oblanceolate to elliptic, obtuse to rounded, cucullate, with closely set parallel fibers or veins, entire to shortly erose, those subtending secondary axes or large flower groups 10–15 mm, those subtending flowers 5–7 mm. *Flowers* sessile in heads of 5 to 15, whether distylous or homostylous unknown; hypanthium cylindrical, ca. 1 mm, glabrous; *calyx limb* ca. 2 mm, glabrous, membranaceous, 5-lobed for 1/5 to 1/4 its length, lobes narrowly triangular; *corolla* tubular, white to pink, externally glabrous, tube 4–6 mm, ca. 1 mm diam. near middle, weakly swollen at base, straight to curved along its length, internally with pilosulous ring near middle, lobes 5, narrowly triangular, 1–2.5 mm, abaxially smooth, at tips cucullate and with apical thickening; *anthers* and *stigmas* not seen. *Infructescences* similar to inflorescences or perhaps becoming purple; *fruit* narrowly ovoid, ca. 4 × 2.2 mm, glabrous, blue; *pyrenes* 2, hemispherical, abaxially with 4 to 5 obtuse angles or ridges, adaxially plane except with a medial furrow, this furrow with a low median ridge.

Phenology. *Palicourea shuar* has been collected in flower in February, May, and December, and with fruits in February.

Habitat and distribution. This species is found in wet forest at 600–1200 m in central and southern Ecuador and northern Peru.

Notes. *Palicourea shuar* is characterized by its generally unbranched and somewhat fleshy habit; its well-developed bilobed laminar stipules; its rather large leaves with numerous secondary veins that are united in a submarginal vein and lack evident intersecondary veins; its shortly pedunculate, deflexed inflorescences that are subcapitate, rounded-corymbiform in outline; its white to pink or purple rather well-developed bracts; its short calyx limbs; and its rather short tubular corollas. The dried specimens of this new species frequently have a marked reddish brown or orangish brown tinge. The lamina surfaces on the undersides of the leaves have unusually large epidermal cells and probably are pale or perhaps shiny in life. *Palicourea shuar* has been collected occasionally over a broad geographic range, which suggests that although it is widespread it may not be common in any local area. This new species has been collected in several localities within the territory of the Shuar people, and its name refers to this indigenous group.

Palicourea shuar is similar to *Pal. mistratoana* of western Colombia, described above; *Pal. mistratoana* can be separated by its habit as a small tree, its branched inflorescences with a well-developed primary axis, and its smaller bracts. *Palicourea shuar* is also similar to *Pal. sopkinii* of western Colombia; *Pal. sopkinii* can be distinguished by its stipules that are emarginate to shallowly lobed for less than one fourth of their length, along with its spiciform erect inflorescences with well-developed primary axes and its larger bracts, 15–20 mm long. *Palicourea shuar* is also similar to *Pal. awa* C. M. Taylor of northwestern Ecuador and adjacent southwestern Colombia, which shares with *Pal. shuar* a similar arrangement of the leaf venation and inflorescences and a similar yellowish brown or orangish brown drying color. However, *Pal. awa* can be separated by its habit as a larger shrub or small tree, its hirtellous or pilosulous pubescence, its stipules that are united around the stem into a well-developed truncate sheath with two narrow lobes on each side, and its laxly cymose inflorescences that are branched to two or three orders with the axes all developed and the flowers separated on dichasial axes. *Palicourea shuar* is also similar to some species of *Notopleura* subg. *Notopleura*, which are also fleshy, unbranched subshrubs; *Notopleura* can be separated by its consistently pseudoaxillary inflorescences that initially develop at nodes below the stem apex, while *Pal. shuar* has terminal inflorescences that develop at the stem apices.

Paratypes. ECUADOR. **Morona-Santiago:** cantón Morona, Cordillera Cutucú, centro Shuar Uunsuant/Trans-

kutuku, *W. Palacios, N. Jaramillo & F. Nicolalde 15744* (MO). **Pastaza:** Veracruz, *E. Asplund 19462* (S); along rd. betw. Puyo & Macas, S of Puyo at Km. 19, *T. B. Croat 50542* (MO); cantón Puyo, Los Vencedores, Estación Experimental E.S.P.O.C.H., Km. 32, Puyo–Macas rd., *D. D. Soejarto, R. E. Pinos, S. Peñafiel, F. Romero, et al.* [sic] *9367* (F, HUA), *9592* (F). PERU. **Amazonas:** distr. Baguas, Aramango, Soldado Oliva, *R. Vásquez, C. Vargas, J. Yactayo & E. Palomio 26004* (MO).

12. Palicourea sopkinii C. M. Taylor, Novon 7(2): 194, fig. 2C, D. 1997. TYPE: Colombia. Chocó: Mpio. San Jose del Palmar, Cerro del Torrá, vertiente NE, arriba del helipuerto, 1970 m, 9 Jan. 1984, *P. A. Silverstone-Sopkin, N. Paz, A. Duque & H. Bayona 1663* (holotype, MO-3230892!; isotypes, CUVC!, MO-3230900!).

Habitat and distribution. This species is found in wet forest at 1500–2500 m in the Cordillera Occidental of the Andes, in western Colombia.

Notes. *Palicourea sopkinii* is a striking species that is characterized by its rather robust habit, its oblanceolate leaves with 15 to 25 pairs of secondary veins, its rather short petioles (0.8–2.5 cm long), and its distinctive reddish purple pedunculate inflorescences with developed secondary axes that each bear subcapitate groups of flowers enclosed by well-developed bracts, 15–20 mm long. The flowers of *Pal. sopkinii* were originally described as sessile or subsessile in glomerules, but with more material of this species available now, the flowers clearly are actually borne in short, congested cymes. As in other species of *Palicourea* sect. *Chocoanae*, these cymes are short and congested initially and then their axes elongate as the fruits develop. *Palicourea sopkinii* is showy but has not been commonly collected, probably in part because the area from which it is known is challenging to access and poorly known botanically.

Palicourea sopkinii is similar to *Pal. timbiquensis*; for details of their separation see the notes for *Pal. timbiquensis*, below. *Palicourea sopkinii* is also similar to *Pal. mistratoana* and *Pal. shuar*, both newly described above; the separation of those species is detailed in the notes for both.

The protologue of *Palicourea sopkinii* noted that two specimens of the type collection were deposited at MO, and one of these was designated as the holotype and the other as the isotype (Taylor, 1997b). These specimens comprise two separate sheets of *Silverstone-Sopkin et al. 1663*, each of which suffices to clarify the identity and characters of this species, and which were annotated at the time of publication by Taylor with their corresponding type status and identified individually by accession number in the protologue. The numbering of those individual sheets as part of the same collection was done to organize a set of mixed unidentified specimens of Rubiaceae in which duplicates intended for distribution were mistakenly also mounted, rather than to designate these sheets as part of one type specimen. The explicit designation of one sheet as the holotype was done not only because provisions of the Tokyo Code (discussed previously in the notes for *Pal. acanthacea*) required it, but primarily because this single sheet is fully adequate by itself to serve as the holotype. Therefore, the two duplicates at MO should not be considered components of a multipart holotype that the author did not intend to designate (see also the notes for *Pal. grandistipula* for discussion of this issue).

13. Palicourea tamaensis (Standl. & Steyerm.) Steyerm., Acta Bot. Venez. 6: 153. 1971. Basionym: *Psychotria tamaensis* Standl. & Steyerm., Fieldiana, Bot. 28: 607. 1954. TYPE: Venezuela. Táchira: base of Páramo de Tamá, 4–10 km above Betania, 2500–2895 m, 15 July 1944, *J. A. Steyermark 57309* (holotype, F-1183095!; isotype, VEN-15868 image!).

Habitat and distribution. This species is found in wet forest at 2500–3020 m in the Cordillera Oriental of eastern Colombia (Boyacá, Norte de Santander) and western Venezuela (Táchira).

Notes. *Palicourea tamaensis* is characterized by its habit as a subshrub or low shrub to ca. 1.5 m tall; its laminar stipules, 8–15 mm long, that are deeply bilobed; its petiolate ovate leaves with blades that are rather small (6–11 × 3–4.5 cm); its deflexed pedunculate inflorescences that are subcapitate to shortly corymbiform with purple bracts 10–15 mm long; its rather well-developed calyx limbs ca. 3 mm long; its somewhat small corollas (with tubes ca. 10 mm long); and its rather small ovoid fruits, ca. 7 × 5 mm. *Palicourea tamaensis* was circumscribed more broadly by Steyermark (1971), who included within this species also the plants separated here as *Pal. psilophylla*; the separation of these is detailed above in the notes for *Pal. psilophylla*.

Palicourea tamaensis is similar to the sympatric species *Pal. aschersonianoides* (Wernham) Steyerm., as noted by Steyermark (1971: 152–154), who considered these closely related. However, Taylor (1997a) considered them less close, and classified *Pal. aschersonianoides* in *Palicourea* sect. *Psychotrioides* C. M. Taylor and *Pal. tamaensis* in *Palicourea* sect. *Cephaeloides*. *Palicourea ascherso-*

nianoides can be separated from *Pal. tamaensis* by its densely rugulose or bullulate leaves and its smaller yellow bracts, 2–5 mm long.

14. Palicourea timbiquensis (Standl.) C. M. Taylor, comb. nov. Basionym: *Cephaelis timbiquensis* Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 7(1): 81. 1930. *Psychotria timbiquensis* (Standl.) C. M. Taylor, Novon 4(3): 306. 1994. TYPE: Colombia. Cauca: Río Timbiquí, 0–200 m, Jan., *F. C. Lehmann 8991* (holotype, K [K000432946] image!; isotypes, COL-18391!, F-630703!, F-591548!).

Habitat and distribution. This species is found in wet forest at 0–600 m in western Colombia and northwestern Ecuador.

Notes. *Palicourea timbiquensis* is characterized by its robust habit, its medium-sized petioles 1.5–3 cm long, its elliptic leaf blades with 12 to 16 pairs of secondary veins and evident intersecondary veins, and its pedunculate, reddish purple inflorescences with a well-developed primary axis bearing several pairs of ovoid flower heads with well-developed bracts. The flower heads are borne variously directly on the primary axis or more often on shortly developed secondary axes, and enclosed by lanceolate to ovate bracts 18–25 mm long. *Palicourea timbiquensis* is rather commonly collected in its range, and forms large stands in secondary openings and edges of forests (C. M. Taylor, pers. obs.).

Palicourea timbiquensis has often been confused with *Pal. acanthacea*, which is sympatric and similar in general aspect and inflorescence color, and which also forms large stands in sunny secondary vegetation. *Palicourea acanthacea* can be separated by its leaves with more numerous secondary veins (30 to 44 pairs); its longer petioles, 6.5–11 cm long; and its subsessile to shortly pedunculate, subcapitate inflorescences with the primary and secondary axes not elongated. *Palicourea timbiquensis* is also similar to *Pal. sopkinii*; *Pal. sopkinii* can be recognized by its leaves with more numerous secondary veins (15 to 25 pairs) and lacking evident intersecondary veins, and also apparently has a distribution at higher elevations, 1500–2500 m.

15. Palicourea trianae (Standl.) C. M. Taylor, comb. nov. Basionym: *Cephaelis trianae* Standl., Publ. Field Mus. Nat. Hist., Bot. Ser. 7(1): 82. 1930. *Psychotria aviculoides* J. H. Kirkbr., Acta Amazon. 10: 103. 1980, nom. nov., non *Psychotria trianae* Standl., 1936. TYPE: Colombia. Prov. de Barbacoas i Chocó [sic], 500–900 m, Apr. 1853, *J. J. Triana 1671* or *3146.33* (holotype, K [K000432862] image!; isotype, BM n.v.; possible isotype, COL-18392!).

Habitat and distribution. This species is found in wet forest at 50–1900 m in western Colombia and northwestern Ecuador.

Notes. *Palicourea trianae* is characterized by its somewhat robust habit; its somewhat short petioles, 1.5–2 cm long; its oblanceolate leaves with 14 to 18 pairs of secondary veins; and its distinctive subsessile, cylindrical, blue or purple inflorescences with well-developed (15–20 mm long), rounded bracts. The inflorescences of *Pal. trianae* have the bracts closely imbricated and appearing spirally arranged. These bracts are generally suborbicular in shape and enclose short cymes of smaller bracts and flowers. As in other species of *Palicourea* sect. *Chocoanae*, these cymes are initially very short and congested, but as the fruits develop their axes and pedicels elongate. Kirkbride (1980: 103–104, fig. 9) presented a description of this species and a photograph of its type. *Palicourea trianae* is not uncommonly collected in western Colombia.

As Kirkbride (1980: 103) noted, *Palicourea trianae* is similar to and commonly confused with *Pal. cotejensis*, which is found in the same region but quite uncommonly collected. The separation of these two species is detailed in the notes for *Pal. cotejensis*, above.

Triana's collections are sometimes problematic for determining what specimens belong to a single gathering, because his sheets are most often numbered according to the identity of the species on his floristic checklist rather than as individual collections. Kirkbride (1982) described Triana's basic numbering system and noted that each specimen in the fully curated sets at BM and COL bears two different numbers. The first number corresponds to an individual collection number, while the second number has one or two parts. In this second number, either the entire number or its first part corresponds to Endlicher's genus number for that species, and the second part when present denotes either the species identification in a taxonomic list or the number of Triana's individual gathering of that particular genus. Thus, when this second number is assigned based on the identity of the specimen and collection number is not noted, whether collections represent different gatherings of the same species cannot be determined. Kirkbride (1980: 103–105) analyzed the problematic numbering of the type specimen of *C. trianae* in detail and

clarified some aspects of it. He showed that Triana's original collection number in Colombia for this specimen or gathering was *1671*, and that this number was transcribed incorrectly on the Kew specimen as "1677." This incorrect number of the Kew duplicate was cited by Standley as the type number for *C. trianae*, and this number does correspond to the label on the Kew specimen he intended to cite as the type but presents problems for finding duplicates of this gathering. Kirkbride also documented the second, taxonomic number of this particular collection, *3146.33*, which represents Endlicher's genus number for *Palicourea* along with Triana's individual number for this species on his list (or perhaps the number of this gathering of this genus). The Triana specimen deposited at COL was numbered only to genus by Triana, as *3146*. This COL specimen was later annotated by Kirkbride as being Triana's number "1671 or 1672," and this specimen may be an istoype. The holotype collection at K has two flowering branches with an additional leaf, and Standley noted that the leaf does not belong to *C. trianae*; this extra leaf appears to belong to *Pal. acanthacea* or *Pal. timbiquensis*.

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Studies in Andean *Ocotea* (Lauraceae) IV. Species with Unisexual Flowers and Densely Pubescent Leaves, or with Erect Pubescence or Domatia, Occurring above 1000 m in Altitude

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Abstract. A revision of the Andean species of *Ocotea* Aubl. occurring above 1000 m elevation with unisexual flowers and dense pubescence on the lower leaf surface or with erect pubescence or with domatia is presented. A key to and descriptions of the 35 recognized species are provided. Twenty-one species are described as new: *O. antioquiensis* van der Werff, *O. argyrea* van der Werff, *O. otara* van der Werff, *O. santamartae* van der Werff, and *O. subparamicola* van der Werff from Colombia; *O. aquila* van der Werff, *O. euryphylla* van der Werff, *O. oreophila* van der Werff, *O. pastazensis* van der Werff, and *O. rufotomentella* van der Werff from Ecuador; *O. crassipedalis* van der Werff, *O. crinita* van der Werff, *O. kolera* van der Werff, *O. megistophylla* van der Werff, *O. palcazuensis* van der Werff, *O. papyracea* van der Werff, *O. satipensis* van der Werff, and *O. tarmensis* van der Werff from Peru; *O. adusta* van der Werff and *O. carchiensis* van der Werff from Colombia and Ecuador; and *O. recurvata* van der Werff from Ecuador and Peru. *Ocotea caesariata* van der Werff is published as a replacement name for *Pleurothyrium velutinum* Meisn., incorrectly called *O. calophylla* Mez.

Key words: Andes, Bolivia, Colombia, Ecuador, IUCN Red List, Lauraceae, *Ocotea*, Peru, Venezuela.

This is the fourth part of a treatment of the Andean species of *Ocotea* Aubl. (Lauraceae). It treats species occurring above 1000 m in altitude in Venezuela, Colombia, Ecuador, Peru, and Bolivia with unisexual flowers and with the lower leaf surface completely covered by pubescence or with erect pubescence on the leaves or with domatia. The remaining species with unisexual flowers will be dealt with in the fifth part. The first three parts dealt with the species with hermaphroditic flowers (van der Werff, 2012, 2013, 2014). The last comprehensive treatment including the Andean Lauraceae was published by Mez (1889); subsequently, assorted new species have been published by Schmidt (1933) and van der Werff (1991, 1994, 2003). However, intensive collecting programs during the past decades, especially in Ecuador and Peru, have resulted in a large number of novelties. This installment presents keys to and descriptions of a number of *Ocotea* species with unisexual flowers. In the first four parts of this series, including the present one, descriptions of 97 species have been offered of which 58 were undescribed. All specimens studied are listed in Appendix 1.

Ocotea is the largest genus of Lauraceae in the New World; the number of species has been estimated at ca. 350 (Rohwer, 1993), but that estimate is probably too low given the number of species described since that date. An estimate of 400 species is more likely to be correct. Our knowledge of relationships among *Ocotea* species is still incomplete. Rohwer (1986) published a very useful overview of *Ocotea* s.l. and listed a number of species groups based on morphology. Chanderbali et al. (2001) presented the most complete phylogeny of Lauraceae to date and found that *Ocotea* was not monophyletic but consisted of five distinct species groups. The species with unisexual flowers fell in one clade, together with two other Neotropical genera with unisexual flowers (*Endlicheria* Nees and *Rhodostemonodaphne* Rohwer & Kubitzki). However, these results are preliminary because only 10 *Ocotea* species with unisexual flowers were included in this study.

Among the Andean *Ocotea* species with unisexual flowers two rather large species groups can be recognized. The largest one was not recognized in Rohwer (1986) and will be called the Ocotea smithiana group. Characteristic for this group are large staminate flowers (6–9 mm diam.) with large stamens (2 mm or more, with the exception of *O. crinita* van der Werff) and a well-developed pistillode, sessile or subsessile leaves, thick twigs (4–14 mm diam.; mostly 6–9 mm), and pale bark, often with horizontal lenticels. The cupules are mostly bowl-shaped. This group ranges from Colombia to Peru, and in this publication 12 species (Table 1) are part of this group. Of these, nine species are newly described; several more are awaiting description in the fifth publication devoted to Andean *Ocotea*. The second largest group is the Ocotea minarum group of Rohwer (1986) and includes six

Table 1. Species of the Ocotea smithiana group.

Ocotea adusta van der Werff
Ocotea antioquiensis van der Werff
Ocotea argyrea van der Werff
Ocotea caesariata van der Werff
Ocotea carchiensis van der Werff
Ocotea crinita van der Werff
Ocotea kolera van der Werff
Ocotea micans Mez
Ocotea oreophila van der Werff
Ocotea otara van der Werff
Ocotea sericea Kunth
Ocotea subparamicola van der Werff

Table 2. Species of the Ocotea minarum group.

Ocotea crassipedalis van der Werff
Ocotea cuneifolia (Ruiz & Pav.) Mez
Ocotea lenitae van der Werff
Ocotea mandonii Mez
Ocotea ovalifolia (Ruiz & Pav.) Mez
Ocotea recurvata van der Werff

species (Table 2), of which two are newly described. Characteristic for this group are small, flat cupules, scarcely more than a thickened pedicel; relatively long and slender terminal buds; flowers with erect tepals often with a densely pubescent inner surface; and in staminate flowers a pistillode with a thickened base and stigma. Most, but not all species in this group, have domatia. Two of the other new species can be assigned to species groups of Rohwer (1986): *Ocotea pastazensis* van der Werff has the pubescent pistil and platelike cupules with a double margin of the Ocotea floribunda group and *O. tarmensis* van der Werff shares the lack of pistillode, lack of filaments of the outer stamens, pubescent floral tube, and glabrous flowers with the Ocotea cernua group. The remaining new species cannot be placed with confidence in the species groups of Rohwer.

There is a great deal of variation in the development of the pistillode in staminate flowers. In some species the pistillode can be absent, as in *Ocotea tarmensis*; in others, it can be slender and threadlike, with or without a stigma, as in *O. velloziana* (Meisn.) Mez; finally, in some species the pistillode has a clearly swollen base and a well-developed stigma, as in the Ocotea minarum and Ocotea smithiana groups. Especially in the latter group the pistillode is very conspicuous, and the staminate flowers can be mistaken for hermaphroditic ones. It is not known if these flowers with well-developed pistillodes are functionally staminate or hermaphroditic. More field studies are needed to answer this question.

Key to Andean *Ocotea* Species Occurring over 1000 m with Unisexual Flowers and the Lower Leaf Surface Completely Covered by Indument or with Erect Pubescence or Domatia Present

1a. Lower leaf surface completely covered by pubescence, surface not visible 2
1b. Lower leaf surface partially covered by pubescence or glabrous, surface at least partially visible 15
2a. Lower leaf surface with tomentellous or tomentose pubescence, hairs erect 3
2b. Lower leaf surface with appressed pubescence 8
3a. Petioles present, 4–15 mm long 4
3b. Leaves sessile or nearly so, a distinct petiole absent 5
4a. Leaf base revolute; leaves 8–17 × 4.5–8.5 cm; domatia lacking ..... 13. *O. euryphylla* van der Werff
4b. Leaf base flat; leaves 5–7.5 × 2–3 cm; small pit domatia present on some leaves but difficult to see ..... 10. *O. crassipedalis* van der Werff
5a. Leaves narrowly obovate, pubescence brown or light brown ..... 15. *O. kolera* van der Werff
5b. Leaves lanceolate, elliptic, or broadly elliptic, pubescence reddish or dark reddish brown 6
6a. Base of leaves plane or slightly revolute; leaves to 3 cm wide ..... 9. *O. carchiensis* van der Werff
6b. Base of leaves markedly revolute; leaves 4–9 cm wide 7
7a. Inner surface of tepals uniformly pubescent, surface completely covered; indument on twigs and leaves tomentellous, hairs on young twigs very short, not exceeding 0.1 mm ..... 28. *O. rufotomentella* van der Werff
7b. Inner surface of tepals glabrous or sparsely pubescent, surface visible; indument on twigs and leaves tomentose, hairs on young twigs ca. 1 mm ..... 8. *O. caesariata* van der Werff
8a. Pubescence on young twigs tomentellous or tomentose, hairs predominantly erect 9
8b. Pubescence on young twigs appressed 13
9a. Leaves petiolate, to 2.5 cm wide ..... 5. *O. arenaria* van der Werff
9b. Leaves sessile or subsessile, 3–13 cm wide 10
10a. Leaves 30–34 × 10–13 cm; twigs 10–14 mm diam ..... 6. *O. argyrea* van der Werff
10b. Leaves to 24 × 3–6 cm; twigs 4–8 mm diam 11
11a. Leaves to 12 cm long, with a short, sharp acumen; shrubs or small trees, to 6 m ..... 33. *O. subparamicola* van der Werff
11b. Leaves 13–24 cm long, acute; trees, 10–35 m 12
12a. Pubescence on twigs blackish brown; staminodia of pistillate flowers with pubescent filaments ..... 1. *O. adusta* van der Werff
12b. Pubescence on twigs gray-brown; staminodia of pistillate flowers glabrous ..... 19. *O. micans* Mez
13a. Style pubescent or at least with several rows of hairs ..... 3. *O. antioquiensis* van der Werff

13b. Style glabrous 14
14a. Leaves with a short (2–4 mm) acumen; tertiary venation weakly raised on the upper leaf surface ..... 32. *O. sericea* Kunth
14b. Leaves acute, without a short acumen; tertiary venation immersed on the upper leaf surface ... 14. *O. guianensis* Aubl.
15a. Lower leaf surface with erect pubescence; domatia absent or rarely present 16
15b. Lower leaf surface without erect pubescence; domatia present 32
16a. Twigs hollow; leaves 17–46 × 11–25 cm ..... 18. *O. megistophylla* van der Werff
16b. Twigs solid; leaves shorter and/or narrower 17
17a. Leaves narrowly elliptic or lanceolate, 18–36 × 4–7 cm ..... 21. *O. otara* van der Werff
17b. Leaves elliptic, broadly elliptic, or obovate, 2–21 × 3.5–11 cm 18
18a. Style densely pubescent; cupules flat, platelike, with a double margin ..... 25. *O. pastazensis* van der Werff
18b. Style glabrous; cupules various but not with a double margin 19
19a. Domatia, tufts of hairs or small pits in the axils of the secondary veins, present 20
19b. Domatia lacking 21
20a. Domatia consisting of tufts of hairs; leaf base decurrent on the petiole and revolute ..... 22. *O. ovalifolia* (Ruiz & Pav.) Mez
20b. Domatia consisting of small pits; leaf base acute, obtuse, or rounded, flat, not decurrent on the petiole or revolute ..... 17. *O. mandonii* Mez
21a. Leaf base revolute and long-decurrent to base of the petiole ..... 30. *O. santamartae* van der Werff
21b. Leaf base flat or if shortly revolute, then not decurrent on the petiole 22
22a. Flowers pubescent, hairs covering more than 1/2 of the surface of the tepals 23
22b. Flowers glabrous or with few scattered hairs 26
23a. Pubescence on twigs and leaves white ..... 7. *O. bofo* Kunth
23b. Pubescence on twigs and leaves brown or red-brown 24
24a. Shrubs or treelets, to 6 m; hairs on twigs 1–2 mm; receptacle glabrous inside; inner surface of tepals pubescent; tepals persisting in fruit; Pasco, central Peru ..... 11. *O. crinita* van der Werff
24b. Treelets or tall trees, 3–30 m; hairs on twigs 0.5–1 mm; receptacle glabrous or pubescent inside; inner surface of tepals glabrous or with some hairs near the base; tepals deciduous in fruit; Ecuador and Colombia 25
25a. Receptacle glabrous inside; leaves elliptic to obovate-elliptic; tall trees, to 30 m; central and northern Ecuador ..... 20. *O. oreophila* van der Werff
25b. Receptacle pubescent inside; leaves narrowly elliptic; small to medium-sized trees; Cordillera Occidental, Choco, Colombia ..... 27. *O. rufa* Mez
26a. Receptacle of staminate flowers glabrous inside 27
26b. Receptacle of staminate flowers pubescent inside 28
27a. Secondary and tertiary veins on the upper leaf surface impressed; pistillode with a distinctly swollen base; fruits ellipsoid, 1.4 × 0.7 cm ..... 29. *O. rugosa* van der Werff
27b. Secondary and tertiary veins on the upper leaf surface immersed; pistillode slender, not swollen at the base; fruits round, 1 cm diam ..... 35. *O. velloziana* (Meisn.) Mez
28a. Pistillode absent in staminate flowers; outer 6 stamens without filaments, anthers sessile ..... 34. *O. tarmensis* van der Werff
28b. Pistillode present in staminate flowers; outer 6 stamens with a distinct filament, this at least 1/2 as long as the anther or longer 29
29a. Twigs sparsely to moderately pubescent, surface clearly visible; pubescence on lower leaf surface sparse to very sparse 30
29b. Twigs densely pubescent, surface largely obscured; pubescence on lower leaf surface moderately dense 31
30a. Tepals erect at anthesis; flowers 2.5–3 mm diam.; leaves 6–11 × 3–5 cm ..... 31. *O. satipensis* van der Werff
30b. Tepals spreading at anthesis; flowers 6 mm diam.; leaves 10–20 × 5.5–11 cm ..... 4. *O. aquila* van der Werff
31a. Tepals ca. 2.5 mm, outer 6 stamens 2.5 mm, filaments of inner 3 stamens pubescent ... 35. *O. velloziana* (Meisn.) Mez
31b. Tepals to 1.8 mm, outer 6 stamens to 1.6 mm, filaments of inner 3 stamens glabrous ... 2. *O. alnifolia* (Meisn.) Mez
32a. Midrib and secondary veins impressed on the upper leaf surface and prominently raised on the lower surface ..... 26. *O. recurvata* van der Werff
32b. Midrib and secondary veins immersed on the upper leaf surface and immersed or weakly raised on the lower surface 33
33a. Leaves coriaceous, to 6 cm long ..... 17. *O. mandonii* Mez
33b. Leaves chartaceous or papyraceous, more than 6 cm long 34
34a. Domatia slits, only along secondary veins, not in the axils of secondary veins; leaves thin-papery ..... 24. *O. papyracea* van der Werff
34b. Domatia pits, slits, or tufts of hairs in the axils of secondary veins, sometimes also along secondary veins; leaves chartaceous 35
35a. Domatia consisting of small axillary tufts of hairs; pistillode stipitiform 36
35b. Domatia consisting of slits or pits, these glabrous or covered by hairs; pistillode swollen at the base 37
36a. Tepals at anthesis erect or half-erect ..... 7. *O. bofo* Kunth
36b. Tepals at anthesis spreading to reflexed ..... 22. *O. palcazuensis* van der Werff
37a. Domatia consisting of slits, 2 or more times longer than wide; leaf apices obtuse, rarely bluntly acute ..... 16. *O. lenitae* van der Werff
37b. Domatia consisting of small, roundish pits in the axils of secondary veins, less frequently along the secondary veins or domatia large, bowl-shaped; leaf apices acute ..... 12. *O. cuneifolia* (Ruiz & Pav.) Mez

1. Ocotea adusta van der Werff, sp. nov. TYPE: Ecuador. Pichincha: Parroquia Calacali, Reserva Geobotanica Pululahua, camino a Lulumbamba, 00°05′N, 78°30′W, 2000–2500 m, 26 Feb. 1987, *C. Cerón, M. Cerón & M. Macías 901* (holotype, MO!, single specimen of 2 sheets). Figure 1.

Ocoteae caesariatae van der Werff similis, sed ab ea pubescentia foliorum adpressa (nec tomentosa) recedit; ab *O. subparamicola* van der Werff foliis majoribus acutis (nec acuminatis), statura majore differt.

Trees, to 35 m. Twigs terete, densely tomentellous-tomentose, surface completely covered, 6–8 mm diam., solid; terminal buds densely appressed pubescent. Leaves alternate, sessile or subsessile, coriaceous, 13–17 × 4.6–6 cm, elliptic, base acute, margin slightly revolute near the base, apex acute, upper surface glabrous, somewhat lustrous, lower surface densely appressed pubescent, sericeous, surface completely covered by the pubescence, midrib immersed or somewhat raised, secondary and tertiary venation weakly raised on the upper surface, midrib raised, secondary and tertiary venation weakly raised on the lower surface, domatia lacking, vernation lines present; secondary veins 12 to 16 on each side, not very prominent. Inflorescences in the axils of leaves, 10–16 cm, paniculate-cymose, densely tomentellous, pedicels to 4 mm, densely pubescent. Staminate flowers not known. Pistillate flowers (old): tepals 3 mm, deciduous in old flowers, outer surface pubescent, inner surface sparsely pubescent, outer 6 staminodia 1.3 mm, filament pubescent, 0.3 mm, inner 3 staminodia 1.8 mm, filament pubescent, 0.8 mm, anther glabrous, 2 glands present at the base of the inner stamens, pistil glabrous, stigma conspicuous, receptacle rather deep, glabrous inside. Fruits 22 × 15 mm, cupule shallowly bowl-shaped, to 14 mm diam., pedicel not swollen in fruit.

Altitudinal range. *Ocotea adusta* is found from 2200 to 2900 m.

Phenology. The single flowering collection was made in February; fruiting collections were made in January and April.

Etymology. The epithet *adusta* is derived from the Latin "adustus," meaning "blackened, brown," after the dark brown color of the pubescence of the twigs.

Vernacular names. Aguacatillo rojo, Yalte, El Magnolia.

Discussion. *Ocotea adusta* resembles *O. caesariata* in leaf size and shape but differs in its appressed pubescence on the lower leaf surface (tomentose in *O. caesariata*). The combination of tomentose pubescence on the twigs and appressed, sericeous pubescence on the lower leaf surface occurs also in *O. subparamicola*, but that species is a shrub or small tree to 6 m (not a tree to 35 m), has an acuminate (not acute) leaf tip, and has smaller leaves (to 10 cm vs. 17 cm) and fruits (to 16 × 10 mm vs. 22 × 15 mm). The distribution of the three species does not overlap. *Ocotea adusta* is known from central Ecuador and Colombia (Quindio, Tolima), *O. subparamicola* from Antioquia (Colombia), and *O. caesariata* from the Cordillera Occidental and Quindio in Colombia, in adjacent Venezuela, and in northern Ecuador (Carchi). Less similar is *O. micans*, which differs in its dense appressed pubescence on its twigs and leaves and in its pronounced revolute leaf base. Collections of *O. adusta* have been identified previously as *O. sericea* (Ecuadorian specimens) or *Ocotea* aff. *micans* (Colombian specimens) and duplicates may have been distributed under those names.

Paratypes. COLOMBIA. **Quindío:** Salento, Reserva Alto Quindío Acaime, 2900 m, 11 Jan. 1990, *L. Renjifo 95* (MO). **Tolima:** La Carbonera, 2750 m, 16 Mar. 1993, *S. Madriñan, S. Arango & M. Salazar 742* (MO). ECUADOR. **Imbabura:** Canton Cotacachi, Caserio Tablachupa, Via a Apuela, 2800–3000 m, 13 June 1992, *B. Cuamacás, E. Gudiño & G. Tipas 151* (MO); a lo largo del camino entre San José de Minas–Pataqui–Hacienda Pisabo–Las Antenas, 2200–3500 m, 27 Apr. 2013, *A. Pérez, F. Coello & R. Zembrano 6211* (MO); vic. of Shanshipamba, 2800 m, 6 Aug. 1989, *H. van der Werff & E. Gudiño 10949* (MO). **Pichincha:** entre Atahualpa–Mojanda Grande, 2600–2900 m, 24 Mar. 2012, *A. Pérez & F. Coello 5274* (MO).

2. Ocotea alnifolia (Meisn.) Mez, Jahrb. Königl. Bot. Gart. Berlin 5: 351. 1889. Basionym: *Oreodaphne alnifolia* Meisn., Prodr. [A. P. de Candolle] 15(1): 132. 1864. TYPE: In Nova Granata, *Goudot s.n.* (holotype, K not seen; isotype, P!).

Shrubs or trees, to 14 m. Twigs angular or terete, 2–4 mm diam., solid, densely pubescent with erect and appressed hairs, erect hairs dominating the aspect, terminal buds densely pubescent. Leaves alternate, petiolate, coriaceous or firmly chartaceous, elliptic, broadly elliptic, or broadly ovate, 5–10 × 3–6 cm, base acute or obtuse to rounded, margin flat, apex acute to obtuse, upper surface glabrous or sparsely appressed pubescent when young, somewhat lustrous, lower surface moderately to densely pubescent, hairs erect and curly, surface visible between the hairs, venation immersed or impressed on the

MISSOURI
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0 1 2 3 4 5 6 7 8 9 10
cm
Ocotea adusta v.d. Werff
Determined by Henk van der Werff 1999
Missouri Botanical Garden 2016
Holotype
Sheet 1 of 2
ECUADOR
TROPICOS
Exsiccatae
LAURACEAE
Ocotea sericea HBK. vel aff.
Det.: H. van der Werff, 1988
Prov. PICHINCHA: Parroquia Calacali. Reserva Geobotánica Pululahua. Camino a Lulumbamba. Bosque Húmedo Montano Bajo; Bosque Seco Montano Bajo; Bosque Húmedo Premontano.
00°05'N 78°30'W 2000-2500 m
Arbol de 20 m. Hojas sentadas, envés pubescente color canela. Inflorescencia color verde. Frutos de 2 cm. de largo ovalados, pedúnculo cupuliforme de 3 cm. de largo. El fuste es utilizado para tablas. Nombre común: El Magnolia
Carlos E. Cerón M., 26 febrero 1987
Miguel Cerón & Myriam Macías 901
MISSOURI BOTANICAL GARDEN HERBARIUM (MO)

Figure 1. Holotype of *Ocotea adusta* van der Werff (*C. Cerón et al. 901*, MO).

upper surface, midrib and secondary veins prominently raised, tertiary venation raised on the lower surface; secondary veins 5 to 8 on each side, domatia lacking; petioles 5–10 mm, terete or flat above, with a similar indument as the twigs. Inflorescences 4–11 cm, in the axils of leaves, paniculate-cymose, densely pubescent, hairs erect, largely covering the surface, pedicels to 1 mm, densely pubescent, flowers subsessile. Flowers yellow-green, 3 mm diam., tepals half-erect, sparsely pubescent to glabrous on both

surfaces, 1.5–1.8 mm; staminate flowers: outer 6 stamens to 1.6 mm, glabrous filaments to 0.5 mm, inner 3 stamens 1.3–1.6 mm, glabrous filaments 0.5 mm, glands present at the base of the inner stamens, staminodia not seen, pistillode threadlike, 1.2 mm, stigma present or lacking; receptacle shallow, pubescent inside; pistillate flowers: staminodia I, II, and III glabrous, 0.7 mm, I and II with a broad sterile anther, III slender, sterile anther only slightly wider than the filament, glands present at the base of the inner stamens, staminodia IV not seen, pistil glabrous, 2 mm, style 0.7 mm, receptacle shallow, glabrous inside. Fruits 1 cm diam., round, cupule shallow, initially with persisting tepals, but tepals not thickened in fruit and breaking off at maturity.

Distribution. *Ocotea alnifolia* is known from Colombia, Ecuador, and Peru at altitudes from 1480 to 2900 m.

Phenology. Flowering specimens have been collected in April, May, June, and October.

Discussion. *Ocotea alnifolia* is a variable species best recognized by the combination of unisexual flowers, erect pubescence on twigs and leaves, subsessile flowers, and a pubescent receptacle of the staminate flowers. Vegetatively it is similar to *O. satipensis*, but that species has larger flowers (longer tepals, larger stamens) with the filaments of the inner three stamens pubescent, not glabrous as in *O. alnifolia*. The type of *O. alnifolia*, *Goudot s.n.*, is the sole collection from Colombia (Tolima, circa Chaparral prope Ortega; this locality written on the P isotype) and has slightly smaller flowers and smaller leaves than the specimens from southern Ecuador. The pubescence on the flowers is also a little denser than on the Ecuadorian specimens, but these differences do not warrant the description of the Ecuadorian specimens as a distinct species. Ecuadorian specimens from lower altitude (*Neill & Kajekai 16614*, 1480 m, MO) have a light brown color of pubescence and elliptic, chartaceous leaves with immersed venation. Collections from higher altitude (for instance *van der Werff & Palacios 8994*, 2500 m, MO) have a darker brown pubescence and ovate, coriaceous leaves with the major veins impressed. Because no differences in floral characters were found, it seems best to maintain *O. alnifolia* as a variable species, but it is possible that once more and better collections are known from Colombia, the Ecuadorian specimens will be recognized as a different and new species.

Selected specimens examined. COLOMBIA. **Tolima:** circa Chaparral prope Ortega, *Goudot s.n.* (P). ECUADOR. **Zamora-Chinchipe:** along the new rd. Loja-Zamora, *van der Werff & Palacios 8994* (MO, QCNE). PERU. **Cajamarca:** San Ignacio, Distr. Huarango, Cordillera Huarango, *Rodríguez et al. 3064* (MO).

3. Ocotea antioquiensis van der Werff, sp. nov. TYPE: Colombia. Antioquia: Mpio. de Briceño, 1–2 km from hwy. on rd. to Briceño, 07°00′N, 75°25′W, 1900 m, 25 Nov. 1988, *G. McPherson 13269* (holotype, MO!; isotype, HUA!). Figure 2.

Ocoteae sericeae Kunth similis, sed ab ea stylo pubescente, foliis majoribus recedit.

Trees, to 15 m. Twigs 4–7 mm diam., densely appressed pubescent, sericeous indument covering the surface entirely, angular to ridged, solid, terminal buds densely appressed pubescent. Leaves alternate, petiolate, coriaceous or firmly chartaceous, broadly elliptic, 10–17 × 5–7 cm, base acute, shortly decurrent on the petiole and often curved upward and folded over the petiole, margin flat, apex obtuse or bluntly acute, upper surface glabrous, lower surface sericeous, appressed pubescence covering the surface entirely, pubescence beige-brown or creamy, vernation lines visible, but not strong, venation immersed or midrib slightly raised on the upper surface, midrib raised, secondary veins slightly raised and tertiary venation immersed on the lower surface; secondary veins 9 to 11 on each side, domatia lacking; petioles 4–6 mm, canaliculate, with a similar indument as the twigs. Inflorescences to 10 cm, in the axils of reduced leaves or prophylls, these 1.5–2.5 cm, distally on the twigs, densely pubescent, the hairs very short, ascending to erect, peduncle and branchlets often flattened, pedicels ca. 1.5 mm, densely pubescent. Flowers unisexual, pale creamy yellow; staminate flowers 7–8 mm diam., tepals 6, equal, 3 mm, outer surface densely appressed pubescent, inner surface sparsely to moderately pubescent, stamens 9, all 4-locular, outer 6 stamens glabrous, 2 mm, filament 1 mm, inner 3 stamens glabrous, 2 mm, glands present at the base of the inner stamens, pistillode 2.7 mm, ovary swollen, pubescent on the distal 1/2, style 1.5 mm, pubescent or with 3 longitudinal rows of hairs, receptacle cup-shaped, pubescent inside; pistillate flowers not known. Immature fruits roundish, 0.7 × 0.7 mm, apically with a few hairs, young cupules bowl-shaped, 8 mm diam.

Altitudinal range. *Ocotea antioquiensis* has been collected between 1300 and 1900 m.

Phenology. The single flowering collection was made in November; immature fruits were collected in April.

Figure 2. Holotype of *Ocotea antioquiensis* van der Werff (*G. McPherson 13269*, MO).

Discussion. *Ocotea antioquiensis* is similar to *O. sericea* but differs notably in its pubescent style and upper part of the ovary (glabrous in *O. sericea*), longer and wider leaves, inflorescences in the axils of prophylls, the color of the pubescence, and the canaliculate petioles. *Ocotea antioquiensis* is the only species in the Ocotea guianensis group sensu Rohwer (1986) with a pubescent pistil, a canaliculate petiole, and inflorescences in the axils of prophylls.

Paratype. COLOMBIA. **Antioquia:** Mpio. de Urrao, Parque Nacional "Las Orquideas," sector Calles, Quebrada La Bironda, 06°31′N, 76°19′W, 1300–1500 m, 03 Apr. 1992, *D. Cardenas & E. Alvarez 3262* (MO).

4. Ocotea aquila van der Werff, sp. nov. TYPE: Ecuador. Morona-Santiago: Limon Indanza, Parroquia Santa Susana de Chiviaza, 02°57′30″S, 78°19′56″W, 1400 m, 31 Mar. 2006, *C. Morales & D. Reyes 1839* (holotype, MO!; isotypes, B!, HUT not seen, LOJA not seen, NY!, P!, QCNE not seen, US!). Figure 3.

Ocoteae satipensi van der Werff affinis, sed ab ea ramulorum foliorumque indumento sparsiore, foliis in sicco atris recedit.

Small trees, to 5 m. Twigs angular, 4–5 m diam., solid, sparsely to moderately pubescent with minute, ± appressed, white hairs; terminal buds densely pubescent, hairs short, erect. Leaves alternate, petiolate, firmly chartaceous, elliptic to broadly elliptic, 10–20 × 5.5–11 cm, base acute to obtuse, margin flat, apex acute to obtuse, upper surface glabrous but major veins with some appressed or erect hairs, lower surface sparsely pubescent, hairs erect, pubescence denser along the major veins, venation immersed on the upper surface or the major veins slightly impressed, midrib and secondary veins raised, tertiary venation slightly raised on the lower surface; secondary veins 5 to 8 on each side, domatia lacking; petioles 8–13 mm, flat above, with a similar indument as the twigs. Inflorescences in the axils of leaves, 3–9 cm, paniculate-cymose, moderately pubescent with the same minute pubescence as found on the twigs but longer, erect hairs also present; pedicels 1.5–2 mm, sparsely to moderately pubescent with short, erect hairs. Flowers white; staminate flowers with spreading tepals, 6 mm diam., outer surface of tepals very sparsely pubescent, inner surface with some hairs near the base, distally becoming glabrous, tepals 2 mm, outer 6 stamens 2 mm, filaments 0.7 mm, with a few hairs, glands present at the base of the inner stamens, staminodia not seen but remnants of the fallen inner stamens easily confused with staminodia, pistillode threadlike, 1.5 mm, but easily broken and appearing shorter, glabrous, slightly thickened at the tip, receptacle shallow, pubescent inside. Pistillate flowers and fruits not known.

Altitudinal range. The two collections were made at 1400 and 1450 m in altitude.

Etymology. The epithet *aquila* is derived from the Latin "aquilus," meaning "dark colored," referring to the dark color of the dried leaves.

Discussion. *Ocotea aquila* is best recognized by the combination of unisexual flowers, a pubescent receptacle, and relatively large flowers, and by blackish drying leaves. It is closely related to *O. satipensis*, a species known from central Peru, which differs in a denser pubescence on twigs and leaves. The relatively large flowers and large stamens suggest a relationship with the Ocotea puberula group of Rohwer (1986). Although the flowers are pedicellate, the inflorescences are compact with the flowers arranged in rather dense clusters. Young flowers have erect tepals, but in older flowers the tepals become spreading. *Ocotea aquila* is known from two collections, made on the same day and in close proximity, and was found growing on sandstone-derived soils.

Paratype. ECUADOR. **Morona-Santiago:** Limon Indanza, Parroquia Santa Susana de Chiviaza, a 10 km al SE de Santa Susana, 02°57′30″S, 78°19′56″W, 1450 m, 31 Mar. 2006, *D. Reyes & C. Morales 1165* (HUT not seen, LOJA not seen, MO, QCNE not seen).

5. Ocotea arenaria van der Werff, Novon 13: 349. 2003. TYPE: Peru. Amazonas: a few km from Molinapampa, *H. van der Werff, B. Gray, R. Vásquez & R. Rojas 14941* (holotype, MO!; isotypes, B!, HBG!, K!, MO!, NY!, QRS!, TI!, US!).

Small trees, to 7 m. Twigs angular or ridged, 3–4 mm diam., solid, brown tomentellous, surface completely covered by the indument, indument wearing off with age; terminal buds densely brown tomentellous. Leaves alternate, petiolate, stiffly chartaceous, 6–11 × 1.5–2.5 cm, lanceolate or narrowly elliptic, base sharply acute, narrowly decurrent on the petiole, margin flat, apex acute, sometimes bluntly so, venation raised on the upper surface, tertiary venation finely reticulate, midrib raised, secondary and tertiary venation immersed or slightly raised on the lower surface, upper surface glabrous and lustrous, lower surface densely appressed pubescent, surface completely covered, indument not sericeous, vernation lines generally visible on young leaves but not on older leaves, domatia lacking, secondary veins 10 to 14 pairs on each side, weakly developed and difficult to count; petioles 7–13 mm, flat above, with a similar indument as the twigs. Inflorescences 6–14 cm, in the axils of leaves, paniculate-cymose, densely tomentellous, surface not visible. Flowers green, 3–4 mm diam. when tepals erect, 5–6 mm when tepals spreading; staminate flowers: tepals 2 mm, broadly ovate, spreading at anthesis, densely brown tomentellous outside, densely pubescent on the inner

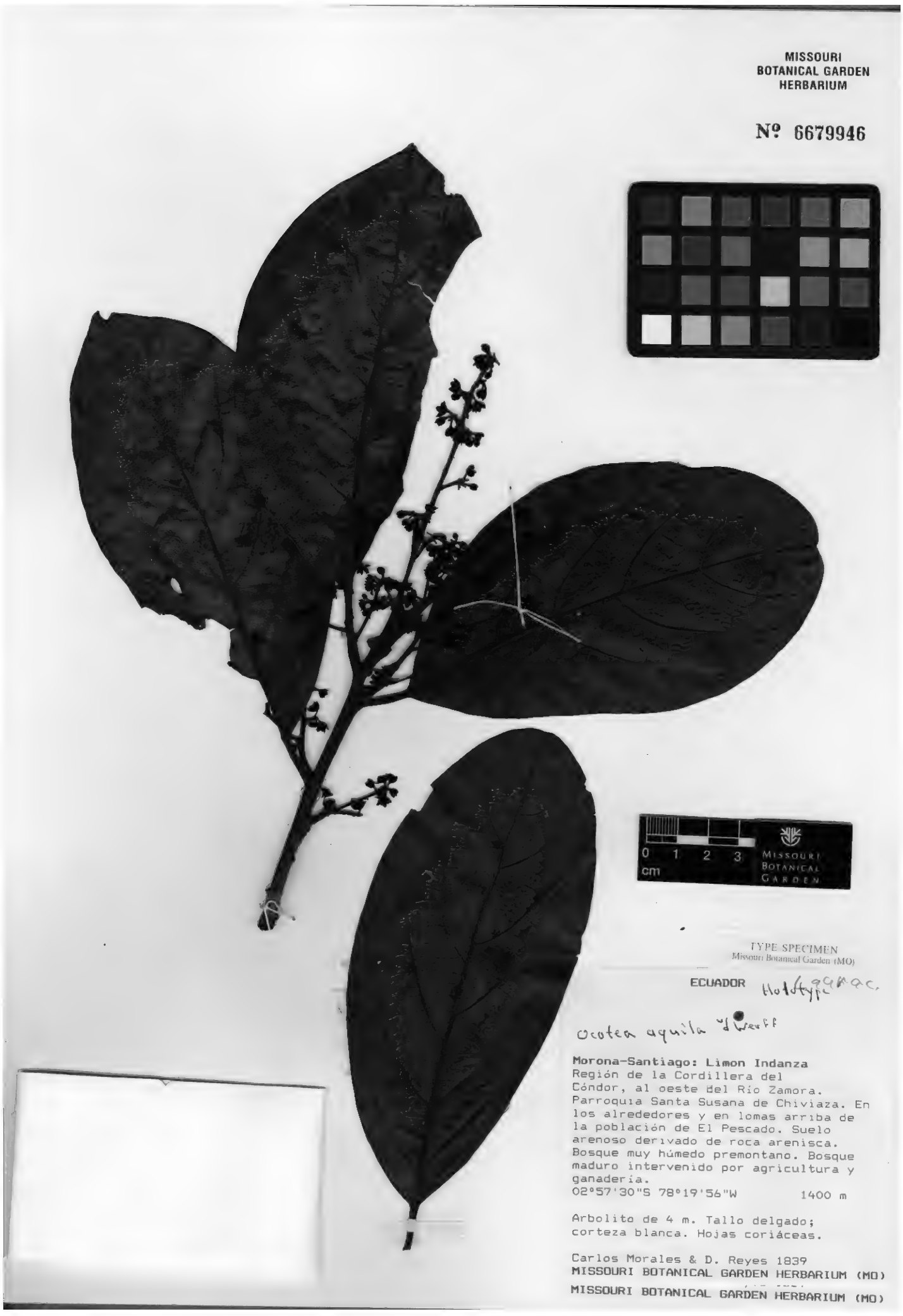

Figure 3. Holotype of *Ocotea aquila* van der Werff (*C. Morales & D. Reyes 1839*, MO).

surface, both surfaces covered by the indument, stamens 9, all 4-locular, outer 6 stamens 1.2 mm, filaments pubescent, much shorter than the anthers, inner 3 stamens 1.5 mm, filament pubescent, ca. as long as the anther, glands present at the base of the inner stamens, staminodia not seen, pistillode 1.5 mm, with a well-developed style and a thickened ovary, receptacle deeply cup-shaped, glabrous except for some hairs near the upper margin; pistillate flowers with tepals as in staminate flowers, but erect

or half-erect at anthesis, staminodia 9, 0.6 mm, glands present at the base of the inner staminodia, pistil 1.5 mm, style ca. as long as the ovary, stigma well-developed, receptacle deeply cup-shaped, glabrous inside. Fruits and cupules unknown.

Discussion. *Ocotea arenaria* can be recognized by the combination of the dense, appressed pubescence of the narrow leaves, the densely pubescent inner surface of the tepals, and the petiolate leaves with flat margins. Its relationships are not clear. Earlier (van der Werff, 2003) I placed this species in the Ocotea guianensis group based on the dense pubescence of the leaves and the vernation lines on the lower surface of the leaves, but a relationship with the Ocotea minarum group based on the dense pubescence of the inner surface of the tepals, narrow leaves, relatively small flowers, and slender terminal buds is more likely. *Ocotea arenaria* is only known from two collections near Molinapampa in Peru where it grows on nutrient-poor, sandy soils. Some associated and uncommon species are *Utricularia* L. sp., Eriocaulaceae, *Pterozonium brevifrons* (A. C. Sm.) Lellinger, *Doryopteris crenulans* (Fée) Christ, and *Dicksonia stuebelii* Hieron.

6. Ocotea argyrea van der Werff, sp. nov. TYPE: Colombia. Valle: Mpio. El Cairo, Cerro del Ingles, 2375 m, 3 Jan. 1987, *F. A. Silverstone-Sopkin, N. Paz, R. González, I. Cabrera, D. Garcés & A. Henso 2897* (holotype, CUVC!; isotype, MO!). Figure 4.

Ocoteae sericeae Kunth et *O. micanti* Mez affinis, sed ab eis foliis majoribus et infructescentiis longioribus recedit.

Trees, 14 m. Twigs terete, 10–14 mm diam., solid, densely pubescent, surface completely covered with short, erect hairs, terminal buds not seen. Leaves alternate, sessile or nearly so, firmly chartaceous, elliptic to broadly elliptic, 30–34 × 10–13 cm, base acute, margin revolute near the base, apex acute, upper surface sparsely appressed pubescent, becoming soon glabrous with age, lower surface densely silvery appressed pubescent, surface completely covered by the indument, vernation lines weakly visible, venation immersed on the upper surface, midrib raised, secondary and tertiary venation weakly raised on the lower surface but poorly visible; secondary veins 20 to 30 on each side, not very prominent, domatia lacking. Infructescences 30 cm, densely tomentellous, hairs erect, covering the surface completely. Flowers not known. Young fruits glabrous, style glabrous. Cupules 1.8 cm wide, 1 cm high, tepals initially persistent, but falling off with age.

Discussion. *Ocotea argyrea* is readily recognized by its large leaves and infructescences, its sessile or nearly sessile leaves with a dense, silvery pubescence, and its thick twigs. These characters indicate a relationship with species including *O. sericea*, *O. micans*, and *O. caesariata*, but *O. argyrea* differs from these species by its large leaves, the dense, appressed pubescence of its leaves, and its tomentellous twigs. The closest resemblance is to *O. micans*, but apart from the differences in size, the pubescence on the twigs of *O. micans* consists of noticeably shorter hairs than found on *O. argyrea*. Although no flowers of *O. argyrea* are known, these vegetative characters are strong enough to allow its identification and description.

7. Ocotea bofo Kunth, Nov. Gen. Sp. 2 (quarto ed.): 161; (folio ed.): 128. 1817. TYPE: Peru. Prov. Jaen de Bracamoros, prope pagam Tomependae, *Humboldt & Bonpland 3646* (holotype, P not seen).

Trees, to 16 m. Twigs terete, 2–3 mm diam., solid, moderately densely pubescent with white, appressed, rarely erect hairs, becoming glabrous with age; terminal buds densely pubescent. Leaves alternate, petiolate, chartaceous, elliptic, broadly elliptic, or slightly obovate, 7–15 × 4–6 cm, base acute to rounded, margin flat, apex obtuse, acute, or acuminate, acumen 0.8 cm, upper leaf surface glabrous or with some pubescence along the major veins, lower surface glabrous or sparsely pubescent with white, erect hairs, pubescence denser along the major veins, upper leaf surface lustrous, venation immersed, tertiary venation raised and forming a fine network, often with many small, black gland dots, secondary veins 4 to 6 on each side, domatia present as small tufts of hairs in the axils of the secondary veins, rarely lacking; petioles 5–10 mm, with a similar indument as the twigs, flat above. Inflorescences in the axils of leaves or in the axils of bracts along leafless short shoots, 5–10 cm, moderately pubescent, paniculate, flowers subsessile and in small clusters, pedicels ca. 0.5 mm, pubescent. Flowers yellow or greenish yellow, 2.5 mm diam., outer surface moderately to sparsely pubescent, tepals erect or half-erect, 1.2 mm, inner surface with some appressed hairs, staminate flowers: outer 6 stamens 1 mm, glabrous, filament 0.3 mm, locelli in 2 pairs, filling the entire anther, inner 3 stamens 0.8 mm with 2 glands at the base of the filaments, locelli lateral, pistillode stipitiform, 1

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№ 3468798
Ocotea argyrea v.d Werff
Determined by Henk van der Werff 1997
Missouri Botanical Garden 2016
Isotype
PLANTAS DE COLOMBIA
HAY FOTOS
Depto.: Valle; Municipio El Cairo
TROPICOS
Nombre: Ocotea micans Mez vel aff.
Exsiccatae
Det.: H. van der Werff, 1987
Familia: LAURACEAE
Cerro del Inglés (Cordillera Occidental, Serranía de los Paraguas, a una hora en jeep de El Cairo, Valle), vertiente norte, bosque nublado primario, 2375 m. Arbol 14 m altura, 36 cm DAP; pecíolo 1.5 cm l.; lámina 33-34 cm l. x 13-13.5 cm a., parte basal del borde fuertemente revoluta; haz un poco áspero, verde oscuro; envés suave, blancuzco a leonado, apariencia sedosa; cúpula 1 cm l. x 1.8 cm a. (en ápice), casi cilíndrica, verrugosa, ápice en forma de estrella de 5 puntas, café oscuro; fruto 1.5 cm l. x 1.1 cm a., elipsoide, verde
Fecha: 3 de enero de 1987 con punticos verde
Felipe A. Silverstone-Sopkin No. 2897 claro.
con N.Paz, R.González, I.Cabrera, D.Garcés, A.Hen
MISSOURI BOTANICAL GARDEN
0 1 2 3 cm

Figure 4. Isotype of *Ocotea argyrea* van der Werff (*F. Silverstone-Sopkin et al. 2897*, MO).

mm, with a peltate stigma, receptacle shallow, pubescent inside; pistillate flowers: outer 6 staminodia 0.8 mm, glabrous, filament as long as the sterile anther, inner 3 staminodia 0.9 mm, glabrous, with 2 large glands at the base, pistil 1.5 mm, glabrous, style 0.5 mm, stigma capitate, ovary 0.8 mm diam., receptacle cup-shaped, glabrous inside, staminodia IV not seen. Fruits ellipsoid, 12 × 7 mm, cupule shallow, 5 mm diam., tepals persistent in fruit, fruiting pedicel swollen.

Phenology. Flowers and fruits have been collected throughout the year.

Distribution. *Ocotea bofo* is a common species, known from Brazil, Bolivia, Colombia, Ecuador, and Peru at altitudes from 200 to 2500 m.

Discussion. *Ocotea bofo* is characterized by paniculate inflorescences with small clusters of sessile flowers, nearly sessile, shallow cupules with persistent tepals, raised tertiary venation, and the presence of small, black gland dots on the upper leaf surface. It is a widespread species in the lowland rainforests and has been reported from Colombia, Ecuador, Peru, Bolivia, and Brazil. In the Andes it has been reported to 2500 m in altitude. Most lowland collections have small domatia, sometimes very small domatia, and glabrous leaves. Initially I had separated the Andean specimens as a possible new species based on the presence of erect hairs on the lower leaf surface and an absence of domatia. Because some Andean collections were found to have glabrous leaves without domatia (for instance *Ortiz & Mateo 1191*, from Peru, Jaen, Santa Rosa, 1250–1600 m, and *Suclli & Farfan 1165*, from Peru, Cusco, Echarate, 1000 m, both at MO) and occasionally lowland specimens have an erect pubescence (for instance, *Silveira et al. 640*, from Brazil, Acre, Mun. Sena Madureira, MO), I include specimens with an erect pubescence and lacking domatia in *O. bofo* as well as specimens with glabrous leaves and without domatia. I consider specimens with hairs on the midrib and secondary veins but without hairs on the lamina as having glabrous leaves.

Selected specimens examined. BOLIVIA. **La Paz:** Franz Tamayo, P.N. Madidi, 29 Nov. 2005, *A. Araujo-M., A. Poma, P. Garagorri, S. Paredes & E. Cuevas 2416* (MO). PERU. **Amazonas:** Luya Province, Camporredondo, 2450–2550 m, 26 May 1989, *C. Diaz, J. Campos & L. Campos 3553* (MO). **Cajamarca:** San Ignacio, Huarango, San Martin del Chinchipe, 05°19′17″S, 78°41′05″W, 900 m, 14 Sep. 1999, *J. Campos, S. Flores & L. Cieza 6199* (MO).

8. Ocotea caesariata van der Werff, nom. nov. Replaced name: *Pleurothyrium velutinum* Meisn., Prodr. [A. P. de Candolle] 15(1): 170. 1864. *Ocotea calophylla* Mez, Jahrb. Königl. Bot. Gart. Berlin 5: 298. 1889, nom. illeg. TYPE: Colombia. Antioquia, *Jervise s.n.* (holotype, K!).

Trees, to 20 m, but often flowering when 4–5 m tall. Twigs angular, 7–9 mm diam., solid, densely tomentose, hairs reddish brown and covering the surface completely; terminal buds densely reddish brown pubescent. Leaves alternate, sessile, coriaceous, elliptic, 12–20 × 4–9 cm, base acute, margin weakly or strongly revolute near the base, apex bluntly acute, upper surface moderately pubescent with erect, crisped hairs, indument denser on the major veins, becoming sparser with age and old leaves glabrous on the upper surface, lower surface densely tomentose, hairs reddish brown and covering the surface completely, vernation lines usually visible, venation immersed on the upper surface, weakly raised on the lower surface, secondary and tertiary venation poorly visible; secondary veins 10 to 12, but poorly visible; domatia lacking. Inflorescences in the axils of leaves, 10–25 cm, densely reddish brown tomentose, paniculate-cymose, flowers crowded; pedicels 1–3 mm, densely tomentose. Flowers unisexual; staminate flowers 6–8 mm diam., tepals 3 mm, spreading, outer surface densely pubescent, inner surface glabrous or sparsely pubescent near the margins, stamens 9, glabrous, all 4-locular, outer stamens 2 mm, filaments 0.7 mm, inner stamens 2 mm, filaments 0.7 mm, 2 globose glands present at the base of the inner stamens, staminodia IV not seen, pistillode 3 mm, glabrous, style 2 mm, stigma conspicuous, peltate, receptacle cup-shaped, glabrous inside; stigma below the tips of the inner stamens; pistillate flowers 8 mm diam., tepals spreading, outer surface densely pubescent, inner surface pubescent, outer 6 staminodia 1 mm, glabrous, inner 3 staminodia 1.2 mm, glabrous, glands present at the base of the inner stamens, staminodia IV not seen, pistil 2.7 mm, glabrous or with a few hairs along the style, style thick, stigma conspicuous, peltate, stigma above the level of the staminodia, receptacle deeply cup-shaped, glabrous inside. Cupule bowl-shaped, margin entire; fruits ellipsoid, to 22 × 12 mm.

Distribution. *Ocotea caesariata* has been collected between 2400 and 3200 m and is known from Colombia, Ecuador, and Venezuela

Phenology. Flowering and fruiting specimens have been collected throughout the year.

Etymology. The new epithet is derived from the Latin "caesariatus," meaning "covered with hair."

Discussion. *Ocotea caesariata* is a distinctive species, readily recognized by its tomentose, reddish brown pubescence, thick, densely pubescent twigs, and large flowers. The pistillode in the staminate flowers is well developed and can easily be mistaken for a pistil; however, it is shorter than the surrounding stamens. The pistillate flowers have greatly reduced

staminodia. The pistil has a thick style and the stigma is raised above the level of the staminodia. This species is known from the Cordillera Oriental in Colombia, adjacent Venezuela, and northern Ecuador.

This species has long been known as *Ocotea calophylla* Mez. Mez proposed this name when he transferred *Pleurothyrium velutinum* Meisn. to *Ocotea*. He did not use *O. velutina* because Nees (1836) listed *O. velutina* Mart. as a synonym of *Oreodaphne velutina* Nees, and Mez thought he could therefore not use the name *Ocotea velutina* (Meisn.) Mez. However, the name *Ocotea velutina* Mart. was a herbarium name and was never validly published. Mez should have made the combination *Ocotea velutina* (Meisn.) Mez; *Ocotea calophylla* Mez is an illegitimate name. The name *Ocotea velutina* is no longer available for this species because Rohwer (1986) published *Ocotea velutina* (Nees) Rohwer based on *Oreodaphne velutina* Nees. Because there is no other legitimate name available to replace *Ocotea calophylla* Mez, I propose the name *Ocotea caesariata* van der Werff as a nomen novum for *Pleurothyrium velutinum* Meisn.

Selected specimens examined. COLOMBIA. **Boyaca:** *Melampy 1266* (MO). **Cesar:** *Garcia-Barriga 20-740* (MO, US). **Cundinamarca:** *Schultes et al. 4053A* (K, US). **Norte de Santander:** Pamplona, *Alston 7230* (US). **Quindio:** *Madriñan 736* (MO); Santander, *Killip & Smith 18153* (US). ECUADOR. **Carchi:** *Palacios 12552* (MO). VENEZUELA. **Anzoategui:** *Davidse 19586* (MO). **Merida:** *Berry 3809* (MO). **Tachira:** *Ruiz-Teran 962* (MO). **Trujillo:** *Cuello 2460* (MO).

9. Ocotea carchiensis van der Werff, sp. nov. TYPE: Ecuador. Carchi: km. 15–18 carretera Pun-Aguarico, 2800–2900 m, 13 Aug. 1949, *M. Acosta Solis 13350* (holotype, F!). Figure 5.

Ocoteae caesariatae van der Werff affinis, sed ab ea foliis angustioribus, foliorum base plana vel vix recurvata recedit.

Trees, of unknown size. Twigs angular, 7 mm diam., tomentellous-appressed, soon becoming glabrous, solid; terminal buds densely pubescent. Leaves alternate, petiolate, firmly chartaceous, lanceolate to narrowly elliptic, 8–14 × 2.5–3 cm, base attenuate, plane or slightly revolute, decurrent on the petiole, apex acute, upper surface glabrous, lower surface ferruginous tomentose, surface completely covered, midrib slightly impressed, secondary and tertiary venation immersed on the upper surface, midrib prominently raised, secondary veins slightly raised and tertiary venation not visible under the pubescence on the lower surface, secondary veins 10 to 12 on each side, domatia lacking; petioles 7–14 mm, flat above. One partly broken inflorescence in axil of leaf, 7 cm, paniculate-cymose, densely ferruginous tomentose, pedicels 1 mm. Flowers unisexual; staminate flowers 8–9 mm diam., tepals spreading, 3–4 mm, outer and inner surface densely pubescent, outer 6 stamens 2 mm, glabrous or with a few hairs on the filament, filament 1 mm, inner 3 stamens 1.8 mm, glabrous, glands present at the base of the inner stamens, pistillode 2.5 mm, ovary swollen, style 1.5 mm, stigma peltate, receptacle cup-shaped, glabrous inside. Pistillate flowers, fruits and cupules not known.

Discussion. Characteristic for *Ocotea carchiensis* is the combination of unisexual, large flowers, ferruginous tomentose indument on the lower leaf surface, dense pubescence on the inner surface of the tepals, and narrow leaves. Its presumed closest relatives are *O. caesariata*, which has broader leaves, revolute leaf margins, and a glabrous inner surface of the tepals; *O. kolera* van der Werff, which differs in its obovate or narrowly obovate leaves; and *O. rufotomentella* van der Werff, which differs in its broader leaves and tomentellous indument. *Ocotea carchiensis* is presently only known from two collections from the Amazonian slope of the Andes in northern Ecuador and from southern Colombia, both poorly explored regions.

Paratype. COLOMBIA. **Cauca:** Cordillera Central, arriba de Coconuco, 3000 m, 18 Feb. 1969, *J. Cuatrecasas & C. Lehmann 27402* (F).

10. Ocotea crassipedalis van der Werff, sp. nov. TYPE: Peru. La Libertad: Distr. Uchumarca, cloud forest E of Laguna Huayllabamba, 06°59′25″S, 77°42′44″W, 3000 m, 3 Nov. 2012, *N. Paniagua Zambrana, R. W. Bussmann & C. Vega Ocaña 8718* (holotype, MO!; isotypes, B!, G!, NY!, US!). Figure 6.

Ad gregem *Ocoteae minarum* (Nees & Mart.) Mez pertinet, sed ab eis foliis parvis, indumento tomentuloso paginam abaxialem foliorum omnino obtegente recedit.

Trees, to 8 m. Twigs terete, slightly angular, 2–4 mm diam., densely brown tomentellous, surface completely covered, solid; terminal buds slender, densely tomentellous. Leaves alternate, petiolate, stiffly chartaceous, elliptic, 5–7.5 × 2–3 cm, base acute, margin plane, apex acute or bluntly acute, upper surface glabrous or tomentellous at the base of the midrib when young, lower surface densely tomentellous, surface completely covered by the indument, venation slightly raised on the upper surface, tertiary venation reticulate, midrib and

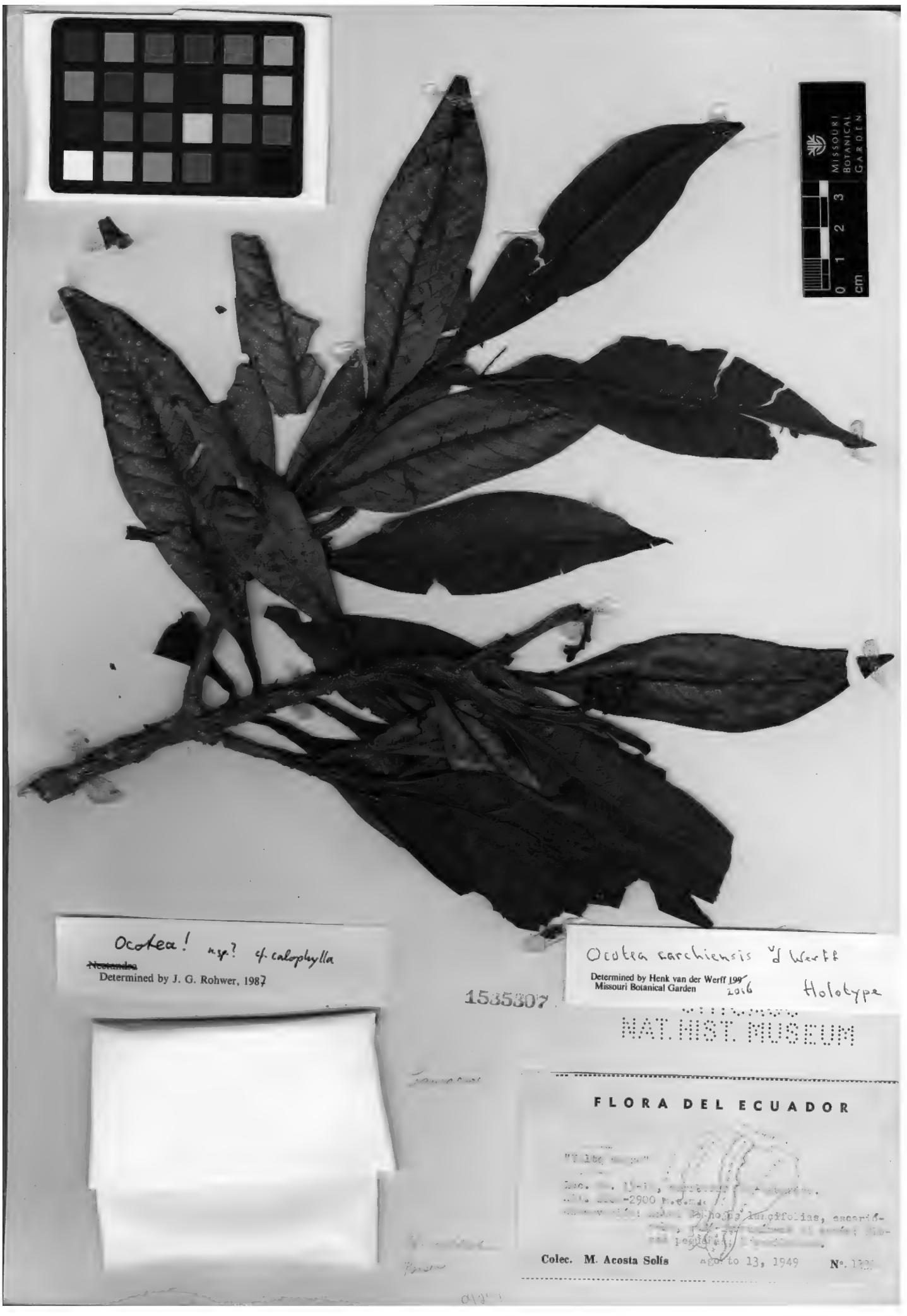

Figure 5. Holotype of *Ocotea carchiensis* van der Werff (*M. Acosta Solis 13350*, F).

secondary veins raised, tertiary venation slightly raised on the lower surface, small pit domatia present at the base of several secondary veins, but largely obscured by the pubescence and best seen on older leaves; petioles 4–7 mm, flat above, with a similar indument as the twigs. Infructescences in the axils of leaves, to 8 cm, densely short-tomentellous. Staminate flowers not known. Remnants of pistillate flowers present at the base of one fruit: tepals 1.5 mm, outer surface sparsely

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Nº 6679948
TYPE SPECIMEN
Missouri Botanical Garden (MO)
PERU Holotype
LAURACEAE
Ocotea crassipedalis J.J.Werff [102]
La Libertad
Dist. Uchumarca. Cloud forest east of Laguna Huayllabamba, close to "La Encañada", with increasing proportion of Lauraceae.
06°59'25"S 077°42'44"W 3000 m
5-8 m tall tree. Leaf underside with dense, woolly, light brown indumentum.
03 November 2012
Narel Paniagua Zambrana, Rainer W. Bussmann & Carlos Vega Ocaña 8718
MISSOURI BOTANICAL GARDEN HERBARIUM (MO)

Figure 6. Holotype of *Ocotea crassipedalis* van der Werff (*N. Paniagua Zambrana et al. 8718*, MO).

pubescent, inner surface more densely pubescent, staminodia 1 mm, 4 locelli faintly visible. Fruits round or nearly so, 2.2 × 2 cm, cupule a small plate, 1 cm diam., the margin undulating, pedicels in fruit distinctly swollen, to 8 mm diam.

Etymology. The specific epithet refers to the thick pedicels of the fruits.

Discussion. The unisexual flowers, swollen pedicels in the fruiting stage, and the small, flat,

platelike cupules place *Ocotea crassipedalis* in the Ocotea minarum group of Rohwer (1986). Within this group only one other species, *O. fendleri* (Meisn.) Rohwer, has a dense pubescence on the lower leaf surface. *Ocotea fendleri* differs from *O. crassipedalis* in leaf size (leaves to 20 cm long), lack of domatia, and distribution (*O. fendleri* is known only from the coastal mountains of Venezuela). Although *O. crassipedalis* is only known from the fruiting type collection, the characters mentioned above allow a placement with confidence in the Ocotea minarum group, and the species is described even though flowers are not known. *Ocotea crassipedalis* differs from the other *Ocotea* species with unisexual flowers and a dense pubescence in its small (to 7.5 cm) leaves and the presence of small pit domatia. Pit domatia are not uncommon in species of the Ocotea minarum group, but they are difficult to see in *O. crassipedalis* due to the dense pubescence. Domatia are better visible on older leaves where the pubescence is partly worn off.

11. Ocotea crinita van der Werff, sp. nov. TYPE: Peru. Pasco: Oxapampa, Milpo, forest fragments on slopes with paramo-like vegetation, 10°23′01″S, 75°37′46″W, 2950–3100 m, 1 Nov. 2009, *H. van der Werff, R. Vásquez, A. Peña, L. Mateo & R. Rivera 23044* (holotype, HOXA!; isotypes, HBG!, K!, MO!, NY!). Figure 7.

Ocoteae mollivillosae van der Werff similis, sed ab ea indumento castaneo, ramulis crassioribus, floribus unisexualibus recedit.

Shrubs or small trees, to 6 m. Twigs terete, densely pubescent with brown, erect hairs, surface completely covered, 5–9 mm diam., terminal buds densely light brown or brown pubescent. Leaves alternate, petiolate, firmly chartaceous to coriaceous, elliptic to ovate, 6–13 × 2–4.5 cm, base acute or obtuse, margin flat, apex acute, upper surface initially moderately pubescent with ascending hairs, becoming glabrous with age, lower surface densely pubescent with erect hairs, surface partly visible between the hairs, indument denser on the major veins; midrib raised, secondary veins and tertiary venation immersed on the upper surface, secondary veins 7 to 10 on each side, domatia lacking; petioles 3–8 mm, canaliculate, densely pubescent. Inflorescences 5–10 cm, in the axils of leaves, paniculate-cymose, densely pubescent, hairs erect, pedicels ca. 1 mm, densely pubescent. Staminate flowers: 6 mm diam., green, tepals 6, equal, 2 mm, spreading to reflexed at maturity, outer surface moderately pubescent, inner surface pubescent, stamens 9, all 4-locular, outer 6 stamens ca. 1 mm, the filament 0.3 mm, with a few hairs, anther glabrous, inner 3 stamens 0.9 mm, filaments with a few hairs, lower pair of locelli much longer then the upper pair, glands present at the base of the inner stamens, staminodia not seen, pistillode 1 mm, glabrous, ovary round, 0.6 mm diam., stigma platelike, well developed, receptacle very shallow, glabrous inside; pistillate flowers: 3.5–4 mm diam., tepals 1.3 mm, indument as in staminate flowers, outer 6 staminodia ca. 0.5 mm, glabrous or nearly so, inner 3 staminodia 0.6 mm, glabrous or nearly so, locelli lacking in staminodia, glands present at the base of the inner stamens, pistil glabrous, 1.3 mm, style 0.3 mm, stigma platelike, receptacle rather shallow, glabrous inside. Fruits ellipsoid, 1.5 × 1 cm, cupule very shallow, platelike, 4–5 mm diam., tepals persisting in fruit, spreading, not or hardly indurate, pedicels thickened toward fruit; occasionally staminodia remain at the base of the fruits.

Distribution. *Ocotea crinita* is known from Peru at altitudes from 2200 to 3000 m.

Phenology. Flowering specimens have been collected in March, October, and November; fruiting specimens in August, October, and November.

Etymology. The epithet *crinitus*, meaning "hairy or long-haired," refers to the conspicuous pubescence.

Discussion. *Ocotea crinita* is a very distinctive species that can be recognized by its densely pubescent twigs and leaves, thick twigs, rotate flowers, and leaves with relatively many secondary veins. The upper surface of older leaves is often somewhat shiny. It is a slender shrub or treelet, by one collector described as monocaul, by others as leaning on other vegetation. It is only known growing on nutrient-poor soils derived from sandstone in scrub vegetation or low forest. Because individual plants have very few flowering twigs (pers. obs.), collectors, when searching for several duplicates, have placed twigs from different plants under the same collection number and as a consequence collections may include both staminate and pistillate flowering twigs. The staminate flowers have a well-developed pistillode and can be easily mistaken for hermaphroditic flowers. It is not known if the staminate flowers are functionally hermaphroditic; at the base of a few fruits staminodes were found, but no stamens.

Paratypes. PERU. **Pasco:** Prov. Oxapampa, Distr. Huancabamba, Milpo, 10°22′33″S, 75°36′48″W, 28 Aug.

Figure 7. Isotype of *Ocotea crinita* van der Werff (*H. van der Werff et al. 23044*, MO).

2004, *A. Monteagudo, A. Peña, J. Perea, R. Francis & Estudiantes curso preparatorio agosto 2004. 7022* (HOXA not seen, MO); Milpo, 22 Sep. 2004, *A. Monteagudo, A. Peña, R. Francis & C. Grob 7244* (HOXA not seen, MO); Milpo, 25 Sep. 2004, *A. Monteagudo, A. Peña, R. Francis & C. Grob 7453* (HOXA not seen, MO); Milpo, 1 Feb. 2005, *A. Monteagudo & R. Francis 8079* (HOXA not seen, MO); Milpo, 18 Mar. 2004, *R. Vásquez, A. Monteagudo, J. Perea, R. Francis & L. Mateo 30191* (HOXA not seen, MO), *30210* (MO); Milpo, 31 Oct. 2009, *H. van der Werff, R. Vásquez, A. Peña, L. Mateo & R. Rivera 22936* (HOXA, MO); Milpo, 2 Nov. 2009, *H. van der Werff, R. Vásquez, A. Peña, L. Mateo & R. Rivera 23125* (HOXA, MO); Milpo, 3 Nov. 2009, *H. van der Werff, R. Vásquez, A. Peña, L. Mateo & R. Rivera 23156* (HOXA, MO); Distr. Oxapampa, P.N. Yanachaga-Chemillen, Flanco Oriental hacia el Valle de Palcazu, 18 Oct. 2006, *A. Monteagudo, D. Catchpole & R. Francis 12901* (HOXA not seen, MO); Distr. Oxapampa, La Suiza Nueva, 10°33′44″S, 75°27′22″W, 6 May 2005, *H. van der Werff, A. Monteagudo, R. Francis, L. Mateo & C. Rojas 19737* (HOXA, MO).

12. Ocotea cuneifolia (Ruiz & Pav.) Mez, Jahrb. Königl. Bot. Gart. Berlin 5: 259. 1889. Basionym: *Laurus cuneifolia* Ruiz & Pav., Laurographia, tab. 359. 1813. TYPE: Laurographia, tab. 359 (lectotype, designated here, tab. 359, Ruiz & Pavón, 1813).

Oreodaphne cuneata Nees, Syst. Laur., 385. 1836. *Ocotea cuneata* (Nees) J. F. Macbr., Publ. Field Mus. Nat. Hist., Bot. Ser. 11: 18. 1931, nom. illeg., non (Griseb.) M. Gómez, Dicc. Bot. Nombres Vulg. Cub. Puerto-Riq. 30. 1889. TYPE: Peru. Ad Cuchero, *Dombey s.n.* (holotype, P not seen).

Oreodaphne oblongo-obovata Nees, Linnaea 21: 518. 1848. *Ocotea oblongo-obovata* (Nees) Rohwer, Mitt. Inst. Allg. Bot. Hamburg 20: 153. 1986. TYPE: Peru. Aus den peru'schen Andes im Wäldern, *Ruiz s.n.* (holotype, B not seen).

Ocotea oocarpa Mez & Sodiro, Bull. Herb. Boissier, Sér. 2, 5: 238. 1905. TYPE: Ecuador. In sylvis subandinis prope Canzacote, *Sodiro 143/2* (lectotype, designated here, B!).

Ocotea raimondii O. C. Schmidt, Repert. Spec. Nov. Regni Veg. 31: 184. 1933. TYPE: Peru. Cajamarca, *Raimondi 6736* (holotype, B!).

Trees, to 35 m. Twigs terete or angular, sparsely appressed pubescent, soon becoming glabrous; terminal buds slender, densely appressed pubescent. Leaves alternate, petiolate, chartaceous, elliptic to obovate-elliptic, 9–14 × 3.5–4.5 cm, base cuneate, margin revolute or flat, apex acute or shortly acuminate, venation immersed on the upper surface, midrib and secondary veins raised, tertiary venation slightly raised on the lower surface, upper surface glabrous, lower surface glabrous or with a few appressed hairs, secondary veins 6 to 10 on each side, domatia present in the axils of secondary veins and along the secondary veins, consisting of small pits or larger circular pits to 0.5 mm diam., usually with a fringe of hairs; petioles 1–1.5 cm, flat above, with a similar indument as the twigs. Inflorescences in the axils of leaves or bracts, 4–9 cm, paniculate-cymose, moderately to sparsely appressed pubescent. Staminate flowers 5 mm diam., tepals spreading at anthesis; tepals 2 mm, elliptic, outer surface sparsely pubescent, inner surface moderately to densely pubescent, stamens 9, all 4-locular, ca. 1 mm, pubescent filaments ca. 0.3 mm, glands present at the base of the inner stamens, staminodia lacking, pistillode 1 mm, glabrous, ovary globose, 0.4 mm, stigma platelike, receptacle shallow, glabrous or with some hairs on the inner surface; pistillate flowers 2.5 mm diam., tepals erect at anthesis, 2 mm, sparsely pubescent, staminodia 9, 0.7 mm, pubescent filament 0.2 mm, pistil 1.5 mm, glabrous, ovary 0.8 mm, gradually narrowed in the style, receptacle shallow, glabrous or with a few hairs on the inner surface. Fruit 2.5 × 2.2 cm, cupule platelike, ca. 7 mm diam., gradually narrowed in the pedicel.

Altitudinal range. *Ocotea cuneifolia* is found from 250 to 3000 m.

Phenology. Flowers have been collected in May, July, September, October, November, and December. Fruits have been collected in June, August, September, and December.

Discussion. Characteristics for *Ocotea cuneifolia* are the presence of pit-shaped domatia along the secondary veins, the acute or acuminate leaf tips, and the narrowly cuneate, revolute leaf bases. This species can be confused with *O. lenitae*, but the latter species has obtuse leaf tips, slit-like domatia, a denser indument on the flowers, and occurs at lower elevations. As accepted here, *O. cuneifolia* is a variable species. The type and a second collection from Peru have relatively broad leaves and almost glabrous flowers. These characters also occur in specimens from northwestern Ecuador (for instance *Aulestia & Grijalva 1203*, MO). Collections from the eastern slope of the Andes in Ecuador have narrower leaves and reddish (instead of yellow-green) flowers (for instance, *Palacios & Freire 4978*, MO). A number of collections, including the types of *O. oocarpa* and *O. raimondii*, have more densely pubescent flowers and large, often pubescent domatia. If no intermediate specimens were known, these forms could be recognized as distinct taxa. However, a number of collections cannot be readily placed in any of the groups, and it seems therefore best to treat *O. cuneifolia* in a broad sense. *Ocotea cuneifolia* can be confused with *O. oblonga* (Meisn.) Mez, a widespread species in the Amazonian lowlands that is occasionally collected on lower Andean slopes. The

most obvious difference between the two species is the absence of domatia in *O. oblonga*; domatia are always present in *O. cuneifolia*.

The publication and typification of the Lauraceae collected by Ruiz and Pavón in Peru and Chile have long been problematic. Nees (1836) did not recognize Ruiz and Pavón's names; Meissner cited as place of publication *Laurographia Peruviana* with collections of Ruiz and Pavón as types; Mez (1889) cited both *Flora Peruviana, et Chilensis IV* and *Laurographia* with collections of Ruiz and Pavón. Kubitzki (1982) accepted as place of publication *Flora Peruviana, et Chilensis IV*, which was published with considerable delay; the publication was planned for 1802 or 1804, but it appeared finally in 1955. The treatment of the *Flora Peruviana* consists of descriptions and plates. The plates, however, were distributed without the descriptions; the library of the Linnaean Society possesses a letter dated 22 July 1813 written by Pavón to J. E. Smith accompanying a gift of the *Laurographia*. Since plates may serve as types, I accept that the taxa attributed to Ruiz and Pavón were published in 1813 and that the plates can serve as the lectotypes of these names.

Selected specimens examined. COLOMBIA. **Quindío:** Mpio. Salento, *Vargas 2679* (MO); Valle, Mpio. Yotoco, *Devia 864* (MO). ECUADOR. **Bolivar:** Via Caluma-Guaranda, *Palacios & Neill 2154* (MO). **Carchi:** Parroquia Chical, *Aulestia & Grijalva 1203* (MO). **Esmaraldas:** San Lorenzo, Parroquia Alto Tambo, *C. & M. Aulestia 1407* (MO). **Imbabura:** rd. Otavalo–Apuela, *van der Werff & Palacios 10573* (MO). **Napo:** Canton Quijos, Baeza, *Palacios & Freire 5014* (MO); Pichincha, rd. Nanegal-Palmitopamba, *van der Werff et al. 12279* (MO). **Zamora-Chinchipe:** rd. from Zumba to Valladolid, *Stein & D'Alessandro 2760* (MO). PERU. **Amazonas:** Luya Prov., Camporedondo, Tullanya, *Diaz & Pena 8714* (MO). **Cajamarca:** San Ignacio Province, San Jose de Lourdes, *Campos et al. 3813* (MO). **Cusco:** La Convencion, Dist. Santa Ana, *Valenzuela et al. 7319* (MO). **San Martin:** Prov. Rioja, Rio Serranoyacu, *Sanchez-Vega et al. 9982* (MO).

13. Ocotea euryphylla van der Werff, sp. nov. TYPE: Ecuador. Morona-Santiago: Limon Indanza, Cordillera de Huaracayo, Ridge E of Shuar Village Tinkimints, 03°15′39″S, 78°11′33″W, 1760 m, 19 Mar. 2001, *D. Neill, P. Berry, J. Manzanares & L. Jost 13061* (holotype, MO!; isotypes, B!, NY!, P!, QCNE not seen). Figure 8.

Ad gregem *Ocoteae velutinae* (Nees) Rohwer pertinet, sed ab eis indumento ferrugineo et foliis base revolutis recedit.

Small trees, to 12 m. Twigs angular to ridged, 4–6 mm diam., rufous tomentellous, solid; terminal buds densely pubescent. Leaves alternate, petiolate, (firmly) chartaceous, broadly elliptic to elliptic, 8–17 × 4.5–8.5 cm, base shortly angustate with a strongly reflexed margin, apex acute to cuspidate, upper surface glabrous and somewhat lustrous, lower surface densely ferruginous tomentellous, surface completely covered by the indument, venation immersed on the upper leaf surface or tertiary venation slightly impressed, midrib and secondary veins clearly raised, tertiary venation slightly raised on the lower surface, secondary veins 5 or 6 on each side, domatia lacking; petioles ca. 1.5 cm, flat or shallowly canaliculate, densely tomentellous. Inflorescences in the axils of leaves, densely tomentellous, 6–16 cm, paniculate-cymose; pedicels to 1.5 mm, densely pubescent. Flowers yellow-green, unisexual, clustered; staminate flowers 4 mm diam., tepals 6, 1.5 mm, outer surface pubescent, inner surface glabrous or with a few hairs near the base, stamens 9, all 4-locular, outer 6 stamens glabrous, 1 mm, filament 0.4 mm, inner 3 stamens 1 mm, locelli lateral, glands present at the base of the inner stamens, staminodia IV not seen, pistil slender, slightly swollen at the base, 1.3 mm, stigma present and peltate, receptacle shallowly cup-shaped, pubescent inside; old pistillate flowers yellow, 2.5 mm diam., tepals half-erect, 1.4 mm, outer surface pubescent, inner surface glabrous, staminodia 9, glabrous, 0.5 mm, glands present at the base of the inner staminodia, pistil glabrous, 1.5 mm, fertilized ovary strongly swollen, receptacle cup-shaped, glabrous inside, but with a ring of hairs at the upper margin. Fruits roundish, 1.3 × 1.1 cm, cupules shallow, platelike, 1 cm diam.

Altitudinal range. The two collections were made at 1760 and 1800 m in altitude.

Vernacular name. Murania Tinchi (Shuar).

Discussion. Ocotea euryphylla is easily recognized by its unisexual flowers, dense ferruginous pubescence, and petiolate leaves with a revolute base. The shape of the cupule and fruits, the slender pistillode with a stigma, and the relatively broad leaves suggest a relationship with the Ocotea velutina group of Rohwer (1986). Within this group it stands apart by its dense ferruginous pubescence and the revolute leaf base. Its closest relative is probably *O. velloziana*, known in the Andean region from Venezuela and Colombia. It bears no relationship to the other species with unisexual flowers and a dense, erect indument; these species (*O. caesariata*, *O. kolera*, and *O. rufotomentella*) have much larger flowers and stamens, a well-developed pistillode in the staminate flowers, thick twigs,

Figure 8. Holotype of *Ocotea euryphylla* van der Werff (*D. Neill et al. 13061*, MO).

sessile or subsessile leaves, and many secondary veins.

Paratype. ECUADOR. **Morona-Santiago:** Limon Andanza, Cordillera de Huaracayo, E of the Shuar village of Tinkimints, 03°15′51″S, 78°11′04″W, 1800 m, 24 Mar. 2001, *D. Neill & J. Manzanares 13167* (MO, QCNE not seen).

14. Ocotea guianensis Aubl., Hist. Pl. Guiane 2: 781. 1775. TYPE: French Guiana, *Aublet s.n.* (holotype, BM not seen).

Trees, to 20 m. Twigs 3–4 mm diam., terete, solid, densely silvery or yellowish appressed pubescent, pubescence covering the surface completely; terminal buds densely appressed pubescent. Leaves alternate, sessile or nearly so, firmly chartaceous, narrowly elliptic, rarely narrowly ovate, 9–18 × 2–5 cm, base acute or angustate, margin flat, apex acute, upper surface glabrous except for the appressed pubescence on the midrib, lower surface densely silvery or golden appressed pubescent, surface completely covered by the pubescence, vernation lines obvious, midrib immersed, secondary and tertiary veins slightly raised and tertiary venation forming a fine reticulum on the upper surface, midrib raised, secondary veins slightly raised and tertiary venation not visible on the lower surface, secondary veins ca. 10 to 12 on each side, but poorly visible, domatia lacking. Inflorescences in the axils of leaves, 10–25 cm, paniculate-cymose, densely appressed pubescent, flowers sessile or pedicels to 2 mm, densely appressed pubescent. Flowers yellow-white or green, unisexual; staminate flowers 3–4 mm diam., tepals 6, erect, 2.5 mm, outer and inner surface pubescent, stamens 9, all 4-locular, outer 6 stamens 1.2 mm, filament 0.2 mm, with a few hairs, anther glabrous, rectangular; inner 3 stamens 1 mm, closely surrounding the pistil, glabrous, each with 2 globose glands at the base, pistillode linear, 2 mm, glabrous, receptacle deep, glabrous inside; pistillate flowers with tepals erect, 2.5 mm, united at the base and falling off in old flowers as a unit, inner 3 slightly shorter, densely pubescent, staminodes 9, 0.7 mm, glabrous, pistil 1.7 mm, glabrous, style much shorter than the ovary, receptacle cup-shaped, glabrous inside. Fruit ellipsoid, 10 × 8 mm, cupule deeply cup-shaped, 8 mm deep, 11 mm wide, with an entire margin.

Altitudinal range. *Ocotea guianensis* is found from sea level to 1500 m.

Phenology. Flowers and fruits have been collected throughout the year.

Discussion. *Ocotea guianensis* is readily recognized by the combination of narrowly elliptic or narrowly ovate leaves with a dense sericeous pubescence on the lower surface, the presence of vernation lines, densely appressed pubescent twigs, and small, unisexual flowers with erect tepals. It is widespread and frequently collected in lowland forests throughout the Amazonian basin (Colombia, Ecuador, Peru, Bolivia, Brazil, Venezuela, and the Guianas) and has been collected a few times on lower Andean slopes in Colombia, reaching an altitude of 1500 m. It has been confused with *O. sericea*, with which it shares dense, sericeous pubescence on the lower leaf surface and the presence of vernation lines. The two species differ as follows: *O. sericea* has shortly acuminate, rather than acute, leaf tips, larger staminate flowers with spreading tepals (to 9 mm diam.), and glabrous inner tepal surfaces. *Ocotea sericea* occurs between 2800 and 3350 m in altitude, whereas *O. guianensis* occurs below 1500 m in altitude.

Selected specimens examined. COLOMBIA. **Antioquia:** Mpio. de Yolombo, Vereda el Bote, *Callejas et al. 7973* (MO, US). **Meta:** Cordilera La Macarena, macizo Renjifo, *Idrobo & Schultes 850* (US). **Santander:** Mesa de los Santos, *Killip & Smith 15172* (US).

15. Ocotea kolera van der Werff, sp. nov. TYPE: Peru. Pasco: Oxapampa, Distr. Huancabamba, Parque Nacional Yanachaga-Chemillen, Parcela Permanente Oso Playa, 10°17′58″S, 75°36′35″W, 2200 m, 31 Nov. 2006, *A. Monteagudo, A. Peña, J. L. Mateo & R. Francis 12924* (holotype, HOXA!; isotypes, HBG!, MO!, NY!, P!, US!). Figure 9.

Ocoteae caesariatae van der Werff affinis, sed ab ea foliis obovatis, indumento cinnamomeo recedit.

Trees, to 30 m. Twigs 6–8 mm diam., terete, solid, shortly tomentose when young, becoming glabrous with age, bark pale and with linear lenticels; terminal buds densely pubescent. Leaves alternate, sessile, firmly chartaceous, obovate or narrowly obovate, 14–30 × 4–6 cm, base narrowly cuneate, margin flat or slightly revolute near the base, apex bluntly acute or obtuse, upper surface tomentellous when young, becoming glabrous with age, lower surface densely tomentose/tomentellous, surface completely covered, indument brown or light brown, midrib, secondary veins, and tertiary venation immersed on the upper surface or the tertiary venation faintly raised, midrib and secondary veins raised, tertiary venation immersed on the lower surface, secondary veins 10 to 15 on each side, domatia lacking. Inflorescences in the axils of leaves, 7–16 cm, paniculate-cymose, densely tomentellous, pedicels ca. 2 mm, densely pubescent. Flowers green, unisexual; staminate flowers 7 mm diam., tepals 6, 3 mm, equal, spreading to reflexed, pubescent on both surfaces, stamens 9, all 4-locular, outer 6 stamens glabrous, 2.5 mm, filament 0.7 mm, inner 3 stamens glabrous, 2.5 mm, filament 1 mm, glands present at the base of the inner stamens, staminodia absent, pistillode

Figure 9. Isotype of *Ocotea kolera* van der Werff (*A. Monteagudo et al. 12924*, MO).

2.5–3 mm, glabrous, ovary swollen, stigma peltate, hidden between the stamens, receptacle deep, glabrous inside; old pistillate flowers with outer staminodia 1 mm, glabrous; immature fruits 4 mm, cupule cup-shaped, tepals deciduous.

Altitudinal range. The four collections were made between 1920 and 2300 m.

Phenology. Flowers have been collected in November; young fruits in June.

Etymology. The epithet is derived from the Greek "koleros," meaning "short-wooled," referring to its pubescence.

Discussion. *Ocotea kolera* can be recognized by the combination of unisexual flowers, sessile, obovate leaves and the dense brown indument. It is presumably related to *O. caesariata*, and the two species share large flowers, large anthers with the locelli occupying the entire anther, staminate flowers with a well-developed pistil, and thick twigs. However, *O. caesariata* differs in its elliptic (not obovate) leaves, reflexed (not flat) leaf base, and reddish brown (not brown to light brown) pubescence. The description of the pistillate flowers is brief because the pistillate specimen had young fruits and few remnants of flowers. It did show that the species has unisexual flowers based on the presence of small staminodia representing whorl I or II. Two collections from the Río Abiseo National Park, Dept. San Martin, Peru (*Young 1423* and *León 2154*, both at MO), resemble *O. kolera* in leaf shape, thick twigs, and dense indument, but differ in their reddish brown pubescence and raised tertiary venation on the lower leaf surface. These collections, both with fruits, probably represent an undescribed species that can be described once flowering specimens are known. They will be annotated as *Ocotea* aff. *kolera*.

Paratypes. PERU. **Amazonas:** Luya Prov., Ocallí, 1920–2300 m, 18 June 1991, *C. Diaz, J. Campos & L. Campos 4354* (MO); Bongara Prov., Shillac, 78°01′W, 05°49′S, 2300 m, 31 Aug.–2 Sep. 1983, *D. N. Smith & S. Vásquez S. 4910* (MO). **Pasco:** Oxapampa, La Suiza Vieja, 10°40′17″S, 75°30′45″W, 2300 m, 28 Oct. 2009, *H. van der Werff, R. Vásquez & C. Rojas 22865* (HOXA, MO).

16. Ocotea lenitae van der Werff, Novon 15: 374. 2005. TYPE: Peru. San Martín: Rioja Prov., along rd. Yorongos–La Florida near Rioja, *H. van der Werff, R. Vásquez, B. Gray & J. Campos 16546* (holotype, HUT!; isotypes, CANB!, HBG!, K!, MO!, NY!, US!, USM!).

Trees, to 45 m. Twigs angled, moderately to sparsely appressed pubescent, becoming glabrous with age; terminal buds slender, densely appressed pubescent. Leaves alternate, evenly distributed along the twigs, petiolate, firmly chartaceous, obovate, 10–18 × 3–7 cm, base narrowly cuneate, margin flat or slightly inrolled, apex obtuse, upper surface glabrous, lower surface glabrous or with some appressed hairs, venation immersed on upper surface, midrib and secondary veins raised on the lower surface; lateral veins 7 to 9 pairs, domatia present as slits, rarely as pits, in the axils of some of the lateral veins, margins of the domatia glabrous; petioles 1–2 cm, shallowly canaliculate. Inflorescences 5–15 cm, paniculate-cymose, sparsely to moderately appressed pubescent, in the axils of leaves or bracts. Flowers yellow or green, staminate flowers ca. 5 mm diam., tepals ca. 1.7 mm, spreading at anthesis, sparsely appressed pubescent on the outer surface, densely pubescent on the inner surface; stamens 9, all 4-locular, outer 6 stamens 1.3 mm, filaments 0.3 mm, pubescent, inner 3 stamens 1.5 mm, filaments 0.5 mm, pubescent, glands present at the base of the inner stamens, staminodia lacking, pistil 1.5 mm, glabrous, swollen at the base, style ca. 1 mm, receptacle shallow, glabrous inside; pistillate flowers ca. 4 mm diam., tepals 1.5 mm, staminodia 9, ca. 0.6 mm, filaments very short, glabrous, glands present at the base of the inner staminodia, pistil 1.6 mm, glabrous, style slightly longer than the ovary; receptacle shallowly cup-shaped, with some appressed hairs inside. Fruits globose, 1 cm diam., cupule small, platelike, 7 mm diam., pedicel and cupule lenticellate.

Altitudinal range. *Ocotea lenitae* is found from 250 to 1000 m.

Phenology. Flowers have been collected in March, May, and June; fruits in January

Vernacular names. Kawa tinchi, ocatoe (Huaorani).

Discussion. *Ocotea lenitae* belongs to the Ocotea minarum group based on its unisexual flowers, small, flat cupules, slender terminal buds, and stamens with very short filaments. Within this group it is distinguished by its leaves with an obtuse apex, slit domatia, and spreading tepals. Its presumed closest relative is *O. cuneifolia*, a species with acute leaf apices and pubescent domatia, which occur also along the secondary veins and are not restricted to the axils of the secondary veins. The domatia of *O. lenitae* are not common, but all specimens have a few domatia. Most collections of this species are from low altitudes, below 1000 m elevation, but a few collections were made at 1000 m in altitude.

Selected specimens examined. ECUADOR. **Napo:** Aguarico, Reserva Etnica Huaorani, *Aulestia 3642* (MO). **Pastaza:** Via Auca, 115 km S of Coca, *Hurtado et al. 1375* (MO). PERU. **Amazonas:** Quebrada yutui entsa, *Ancuash 217* (MO). **Pasco:** Oxapampa, Distr. Huancabamba, Troche turistica (Puente Emperador Guillermo I), *Perea et al. 1290* (MO). **San Martin:** Rioja, along rd. Rioja–Yorongos–La Florida, forest on white sand, *van der Werff et al. 16510* (MO).

17. Ocotea mandonii Mez, Jahrb. Königl. Bot. Gart. Berlin 5: 311. 1889. TYPE: Bolivia. Viciniis Soratra, 2800 m, *Mandon 1043* (holotype, B!).

Ocotea jumbillensis O. C. Schmidt, Repert. Spec. Nov. Regni Veg. 31: 182. 1933. TYPE: Peru. Amazonas: Bongará, Zwischen Jumbilla und San Carlos, 2900–3000 m, 26 June 1915, *A. Weberbauer 7155* (holotype, B!).

Shrubs or small trees, to 15 m. Twigs terete, 2–3 mm diam., solid, glabrous or pubescent and soon becoming glabrous, if pubescent, hairs appressed or erect, terminal buds glabrous or pubescent. Leaves alternate, closely spaced, petiolate, coriaceous, elliptic to broadly elliptic or subrotund, 2.5–6 × 1–3.5 cm, base acute, obtuse, or rounded, margin flat, apex acute, bluntly acute, or rounded, upper surface glabrous, lower surface with appressed or erect hairs when young but soon glabrous, major veins immersed, tertiary venation (slightly) raised and forming a reticulum on the upper surface, venation raised on the lower surface with tertiary venation reticulate, secondary veins 3 to 8 on each side, domatia present as pits in the axils of the secondary veins, occasionally present along the secondary veins; petioles to 6 mm, flat above, glabrous or with a few hairs. Inflorescences in the axils of leaves, to 5 cm, paniculate, very sparsely to moderately appressed pubescent; pedicels 1–2 mm or flowers subsessile. Staminate flowers 4–6 mm diam., tepals half-erect to spreading, tepals 2–2.5 mm, glabrous or moderately appressed pubescent on the outer surface, sometimes pubescence denser on the inner 3 tepals, inner surface sparsely to densely pubescent, stamens 9, all 4-locular, outer 6 stamens 1–1.3 mm, anther 1 mm, glabrous, filament (sparsely) pubescent, inner stamens 1.5 mm, glabrous, filament 0.2–0.5 mm, glands present at the base of the inner stamens, staminodia not seen, pistillode 1.5–2 mm, ovary 1 mm, stigma well developed, disklike; pistillate flowers 3–4 mm diam., tepals ca. 1.5 mm, outer surface glabrous to sparsely pubescent, inner surface sparsely to densely pubescent, staminodia 0.8 mm, filament pubescent, 0.2 mm, pistil glabrous, 1.5–2 mm, receptacle shallow, glabrous or with a few hairs inside. Fruit ellipsoid, 1.8 × 1 cm, cupule shallowly bowl-shaped, 7 mm diam., tepals not persistent in fruit, pedicel swollen.

Phenology. Flowering specimens have been collected in May, August, and November.

Altitudinal range. *Ocotea mandonii* is found from 2200 to 3290 m.

Discussion. As accepted here, *Ocotea mandonii* is a variable species and may well comprise more than one taxon. It is defined by its small, coriaceous leaves with pit domatia in the axils of secondary veins, occasionally along the secondary veins, and its pistillodes with a relatively well-developed ovary. Leaves have often raised reticulation, especially on the lower surface. Vegetatively, there is a great deal of variation. Terminal buds can be glabrous or have appressed or ascending pubescence; the lower leaf surface can be glabrous or densely or sparsely pubescent with erect or appressed hairs; and leaf apices can be acute or rounded. It is possible to recognize a number of vegetatively defined species in this complex. However, before recognizing species based on what I consider weak characters, two requirements have to be met: there must be several collections with flowers and fruits of such species, and these collections must all come from the same area. None of the vegetatively defined entities meet these two requirements. For instance, the type of *O. jumbillensis* has glabrous terminal buds and glabrous leaves; it was collected near Jumbillo in northern Peru. A second collection with glabrous terminal buds (*Valenzuela et al. 9053*, MO) was made near Cuzco, much further south, and has larger leaves with much larger domatia than the type of *O. jumbillensis*. *Smith 4829* (MO) was collected close to the type locality of *O. jumbillensis* but has pubescent terminal buds. The few other collections of *O. mandonii* s.l. do not show any pattern, and given the seemingly random variation of vegetative characters it seems best to recognize one variable species for which the oldest name is *O. mandonii*. Some, but not all, of the labels mention that the specimens were collected in low forest or scrub on nutrient-poor soils.

Additional specimens examined. BOLIVIA. **La Paz:** Prov. Murillo, Valle del Rio Zongo, *Solomon 17466* (MO); Depto. Prov. Inquisivi, communidad Choquetanga-Wichupampa, *Salinas 2719* (MO). ECUADOR. **Loja:** pass on the rd. Loja–Zamora, *van der Werff 9439* (MO), *9451* (MO). **Zamora-Chinchipe:** Estación Cientifica San Francisco, rd. Loja–Zamora, ca. 30 km from Loja, *Homeier 348* (MO). PERU. **Cajamarca:** Contumazá, Bosque Cachil, *Sagástegui & Leiva 15425* (MO); San Ignacio, Huarango, Cordillera entre Romerillo y Nuevo Mundo, *J. Campos et al. 6601* (MO). **Cusco:** La Convención, Distr. Vilcabamba, Yupanca, *Valenzuela et al. 9053* (MO). **Pasco:** Distr. Huancabamba, Parque Nacional Yanachaga-Chemillen, *Monteagudo et al. 12307* (MO). **San Martin:** Rioja Prov., Km. 368, rd. Pedro Ruíz–Moyabamba, *Smith 4829* (MO).

18. Ocotea megistophylla van der Werff, sp. nov. TYPE: Peru. Cajamarca: San Ignacio, Distr. Huarango, Poblado Selva Andina, 05°03′02″S, 78°45′14″W, 1613 m, 25 Apr. 2007, *J. Perea & J. Mateo 3078* (holotype, MO!; isotypes, B!, NY!, P!, US!). Figure 10.

A congeneris floribus unisexualibis praeditis ramulis fistulosis, foliis magnis, petiolis longis recedit.

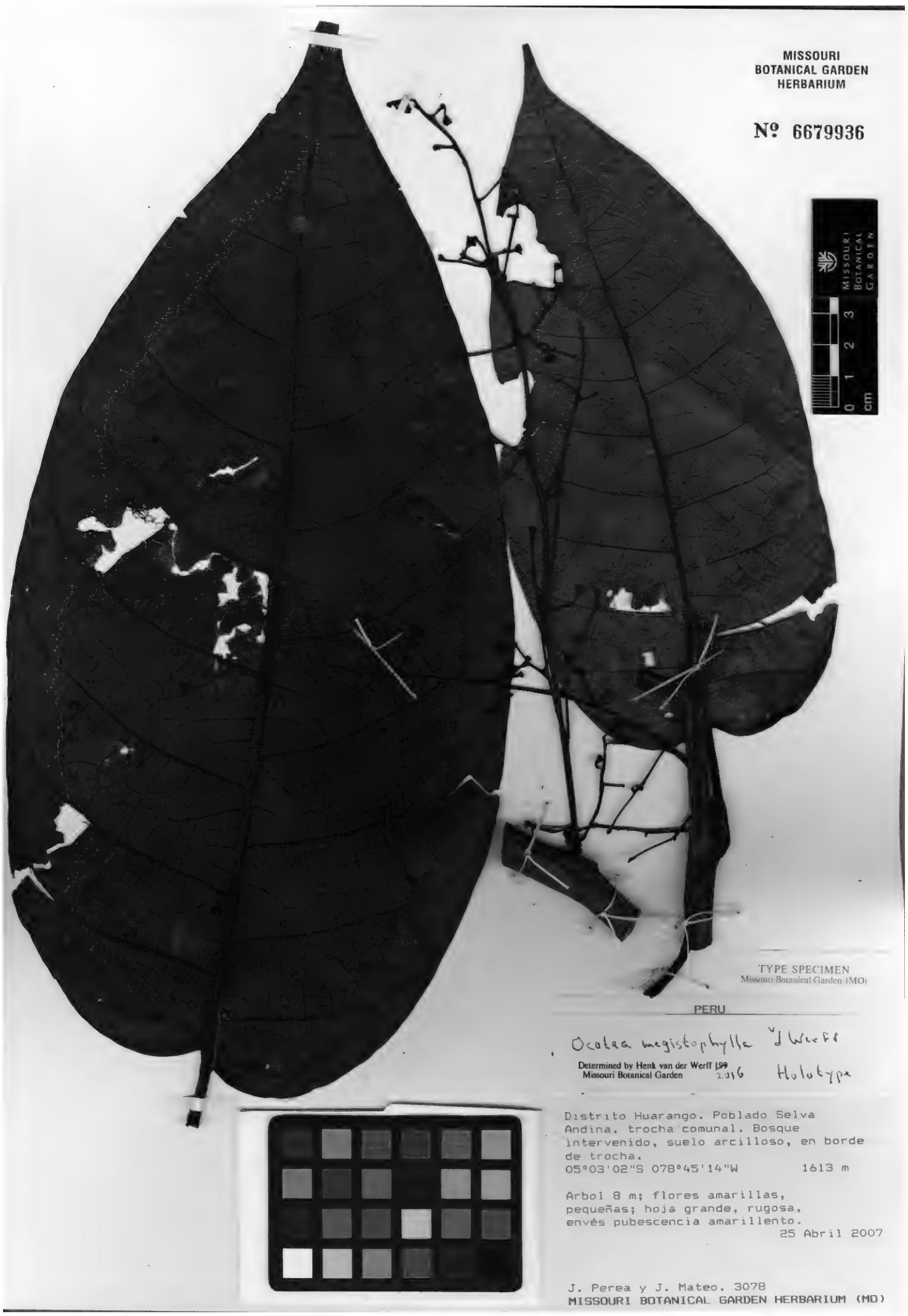

Figure 10. Holotype of *Ocotea megistophylla* van der Werff (*J. Perea & J. Mateo 3078*, MO).

Small trees, to 12 m. Twigs angular, fistulose, 5–11 mm diam., densely brown pubescent, hairs erect, ranging from short-puberulous to 0.3 mm, terminal buds densely brown pubescent. Leaves alternate, petiolate, chartaceous, broadly elliptic, 17–46 × 11–25 cm, base obtuse, rounded, or subcordate, margin flat, apex acuminate, acumen to 2 cm, acute or rounded, upper surface glabrous except for some hairs on the major veins, often lustrous, lower surface moderately pubescent with erect hairs, these dis-

cernible and soft to the touch or indument sparser with short, erect hairs, somewhat scabrous to the touch or glabrous except for moderately dense indument along the major veins, venation immersed or impressed and the upper surface slightly rugose, midrib, secondary veins and tertiary veins raised or weakly raised on the lower surface, secondary veins 8 to 12 on each side, distally loop-connected, domatia lacking; petioles 3–8 cm, flat above, with a similar indument as the twigs. Inflorescences 10–25 cm, in the axils of leaves, paniculate-cymose, densely brown pubescent; pedicels 1–2 mm, densely pubescent. Staminate flowers 2.5–3 mm diam., yellow, moderately to densely pubescent outside, tepals 6, 2 mm, half-erect, sparsely pubescent on the inner surface, stamens 9, all 4-locular, outer 6 stamens 1 mm, glabrous, filament 0.3 mm, inner 3 stamens 1.2 mm, glabrous, anther 0.7 mm, scarcely wider than the filament, glands present at the base of the inner stamens, staminodia not seen, pistillode threadlike, glabrous, 1.5 mm, with a small stigma or stigma lacking, receptacle deep, pubescent inside. Pistillate flowers and fruits not known.

Phenology. Specimens with flowers have been collected in April, May, June, and August.

Altitudinal range. *Ocotea megistophylla* is found from 381 to 1613 m.

Etymology. This species is named after its large (megistos) leaves.

Discussion. *Ocotea megistophylla* is easily recognized by the combination of large leaves, long petioles, fistulose twigs, and erect indument. The four collections of this species show variation in indument: the two collections from Cajamarca have a denser and longer indument on leaves and twigs, and the larger leaves are often subcordate; the collection from Loreto has a shorter indument; and the collection from Pasco has the underside of the lamina almost glabrous with the indument restricted to the major veins, and the leaves have an obtuse base. However, all collections share the four characters cited above, and the indument differences do not warrant recognition of additional species. Relationships of *O. megistophylla* may well rest with the Ocotea velutina group of Rohwer (1986), a group of five species known from southern Brazil. None of the species in this group has hollow twigs, though. Once fruits and cupules are known, a more definitive statement can be made about the relationships of this species. The collection from Loreto has slightly smaller, thicker flowers suggesting that it could have a pistil instead of a pistillode. However, the "pistil" is as thin as in the other dissected flowers, and the flower has normally developed stamens with opened locelli; thus, the flower is staminate.

Paratypes. PERU. **Cajamarca:** San Ignacio, Distr. Huarango, Caserio el Arenal, 05°03′38″S, 78°48′39″W, 1100 m, 24 May 2006, *J. Perea & V. Flores 2336* (MO). **Loreto:** Prov. Danten del Marañon, Distr. Manseriche, Cerros Kampankis, Campamente 4, 03°50′29.52″S, 77°38′20.70″W, 381 m, 18 Aug. 2011, *I. Huamantupa, D. Neill, N. Pitman, C. Kajekai & J. Ramirez 16029* (MO). **Pasco:** Prov. Oxapampa, Distr. Palcazu, P.N. Yanachaga-Chemillen, Cerro Paujil–Ozuz, 10°10′S, 75°10′W, 600 m, 10 June 2005, *A. Monteagudo, A. Peña, R. Francis, J. Mateo & A. Utani 8600* (MO).

19. Ocotea micans Mez, Jahrb. Königl. Bot. Gart. Berlin 5: 297. 1889. TYPE: Colombia, *Triana 1056 (= 2054.4)* (holotype, P!; isotypes, BM!, COL!, K!).

Trees, to 25 m. Twigs angular, 4–7 mm diam., solid, densely tomentellous, surface completely covered by the pubescence, short hairs erect or ascending; terminal buds densely appressed pubescent. Leaves alternate, sessile, firmly chartaceous or coriaceous, elliptic to narrowly elliptic, 13–24 × 4–7 cm, base angustate or acute, margin revolute near the base of the leaves, otherwise plane, apex bluntly acute, infrequently acute, upper leaf surface moderately appressed pubescent when young, soon becoming glabrous, lower surface densely appressed pubescent, somewhat sericeous, surface completely covered, vernation lines visible, upper leaf surface with immersed midrib and secondary veins, tertiary venation not visible, lower surface with raised midrib, secondary veins slightly raised or immersed and tertiary venation immersed and not visible, secondary veins 16 to 20 on each side, domatia lacking. Inflorescences in axils of leaves, 7–17 cm, paniculate-cymose, major axes densely tomentellous, pubescence becoming sparser toward the flowers; pedicels 2–3 mm, densely tomentellous, elongating in fruit and becoming less densely pubescent. Flowers unisexual; staminate flowers not known; pistillate flowers: tepals 6, 2.5–3 mm, spreading to reflexed, outer surface densely pubescent, inner surface sparsely pubescent or subglabrous, staminodia 1 mm, glabrous, glands present at the base of the inner stamens, pistil 2.8 mm, glabrous, style 1.5 mm, stigma discoid, receptacle cup-shaped, glabrous inside. Fruit ellipsoid, 14 × 9 mm, cupule cup-shaped, 7 mm diam., 3 mm high.

Altitudinal range. *Ocotea micans* is found from 1900 to 2500 m.

Discussion. *Ocotea micans* is a poorly known species, best recognized by the combination of densely appressed pubescent lower leaf surfaces and subsessile leaves with an angustate (rarely acute) and revolute base. There is some variation in pubescence on the twigs. Some specimens have only appressed hairs (including the K isotype), others have ascending hairs. Staminate flowers are not yet known, and the type collection is the only one with pistillate flowers. This specimen has old flowers and most of the tepals have fallen off. I have seen only five collections of *O. micans*: the type collection, *Mutis 2918* (US) without locality data, two *Cuatrecasas* collections (*21652* and *22476*, both US) from Depto. del Valle, and *Vargas 4525* (MO) from Depto. del Quindío. Several collections appear to be closely related to *O. micans* but differ in vegetative characters. None of those have flowers; they are either sterile, have buds, or have fruits. They include the following. (1) *Cuello et al. 2479* (MO) from Estado Trujillo, Venezuela, has petioles to 10 mm long; it is sterile. (2) *Fathers Huertos y Camargo 1049* (US) from Colombia without further locality data has relatively broad leaves; it has buds. (3) *Cuatrecasas 19174* and *23506* (both US) from the Depto. del Cauca resemble *O. micans* in leaf shape and size, but the pubescence on the lower leaf surface is ferruginous and the hairs are ascending instead of appressed; one of these collections has immature fruits, and the second one is sterile. (4) *Tomas 1570* and *Tomas s.n.* (both US) from Dept. Antioquia, Yarumal, have lanceolate leaves (14 × 2.5 cm) and twigs that lose their pubescence quickly; the size of *Tomas 1570* is given as 3 m; both collections are in bud. (5) Two collections (*Breteler 4624* and *Marcano-Berti 815* (both MO) from Paramo La Negra, Merida, Venezuela, with pistillate flowers differ in the short, erect pubescence on the twigs. All of these collections will be annotated as *Ocotea* aff. *micans*.

Triana's collections were numbered using two different systems (Kirkbride, 1982). The P set of the Lauraceae collected by Triana was sequentially numbered without locality data. Mez only saw the P specimens for his *Lauraceae Americanae* (1889) and gave the following type information for *Ocotea micans*: "Triana 1056, Hab. in Columbia, loco non indicato." The second numbering system is more complicated; it consists of a number indicating the genus based on Endlicher's *Genera Plantarum* and a second number indicating the species. Labels with this numbering system also have more detailed locality data. Kirkbride (1982) implied that the COL set of Triana's collections were numbered using the more detailed system and that specimens in European or American herbaria were numbered using the sequential system. Triana specimens I have seen from BM and NY are indeed numbered using the sequential system. Fortunately, BM has a handwritten catalogue of Triana's collections, which lists both numbering systems. Specimens of Triana's Lauraceae collections at K have the more complicated numbering system as well as locality data. The catalogue at BM makes it possible to connect labels of the K specimens with those of the P specimens. I have cited both numbers as type numbers for *O. micans* and *O. rufa* and have used the locality data taken from the K specimens.

20. Ocotea oreophila van der Werff, sp. nov. TYPE: Ecuador. Carchi: 30 min. E of Huaca, past Colonia Huaqueña, remnants of tall (20–25 m) forest, 3100–3200 m, 18 Feb. 1989, *H. van der Werff & W. Palacios 10601* (holotype, MO!; isotypes, B!, CAS!, F!, HBG!, K!, NY!, P!, QCNE!, US!). Figure 11.

Ocoteae crinitae van der Werff affinis, sed ab ea indumento breviore sparsioreque, paginis interioribus tepalorum minus pubescentibus et statura majore recedit.

Trees, to 30 m. Twigs terete, 6–8 mm diam., solid, densely brown tomentellous or tomentose when young, indument wearing off with age, terminal buds densely brown pubescent. Leaves alternate, petiolate, firmly chartaceous, elliptic or slightly obovate, 7–14 × 2.5–6 cm, base acute, margin flat or somewhat revolute near the base, apex obtuse or acute, upper surface sparsely pubescent when young, quickly becoming glabrous, lustrous, lower surface moderately to sparsely pubescent, hairs erect and curly, indument much denser along the major veins, midrib slightly raised, secondary veins and tertiary venation immersed on the upper surface, midrib and secondary veins prominently raised, tertiary venation raised on the lower surface, secondary veins 7 to 10 on each side, domatia lacking; petioles 5–12 mm, flat above, with a similar indument as the twigs. Inflorescences in the axils of leaves, 6–12 cm, paniculate-cymose, densely brown tomentellous; pedicels 3 mm, with the same indument as the inflorescence. Flowers green, tepals spreading, outer surface puberulous, inner surface sparsely puberulous near the base, papillose toward the tip; staminate flowers 5–8 mm diam., tepals 3 mm, half-erect to spreading, outer 6 stamens 2 mm, glabrous, filaments 0.6 mm, locelli large and filling the entire anther, inner 3 stamens 2 mm, glabrous, filament 0.7 mm, with 2 globose glands at the base, staminodia IV not seen, pistillode 3 mm, glabrous, ovary 1 mm, style 2 mm, stigma capitate,

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0 1 2 3 4 5 6 7 8 9 10
cm
TYPE SPECIMEN
Missouri Botanical Garden (MO)
ECUADOR Holotype
LAURACEAE
Ocotea oreophila v/d Werff
CARCHI:
About 1/2 hr. E of Huaca, past Colonia Huaceña, remnants of tall (20-25 m) forest.
3100-3200 m
Tree, 10 m. Flowers green, male. This was regrowth of an enormous tree.
Henk van der Werff & Walter Palacios 10601
18 February 1989
MISSOURI BOTANICAL GARDEN HERBARIUM (MO)

Figure 11. Holotype of *Ocotea oreophila* van der Werff (*H. van der Werff & W. Palacios 10601*, MO).

below the level of the anthers in the flower; receptacle cup-shaped, glabrous inside; pistillate flowers with the same indument as staminate flowers, 7–8 mm diam., staminodia 9, outer 6 staminodia 1 mm, glabrous, filament as long as the anther, inner 3 staminodia 1.5 mm, glabrous, filament 0.6 mm, large glands present at the base of the filaments of the inner 3 staminodia, staminodia IV not seen, pistil 3 mm, ovary 1 mm, glabrous, stigma capitate, conspicuous, raised above the level of the staminodia. Fruit

ellipsoid, 2 × 1 cm, cupule shallow, 1 cm diam., tepals deciduous in the fruiting stage.

Altitudinal range. *Ocotea oreophila* is found at altitudes from 3000 to 3500 m.

Phenology. Flowers have been collected in February, April, July, and December; fruits in February and March.

Etymology. The specific epithet is derived from the Greek "oros" (mountain) and "philos" (lover), referring to its occurrence at high altitude.

Vernacular names. Yalte, Yalte Corazón Negro.

Discussion. *Ocotea oreophila* is readily recognized by the combination of large flowers, reddish brown tomentellous indument on the twigs, unisexual flowers, and large size. It is closely related to *O. crinita*, a species with similar flowers, but with a villous indument (long, soft hairs on the twigs) and a much smaller size (shrub or small tree). *Ocotea oreophila* grows on rich, volcanic soils, whereas *O. crinita* is only known from nutrient-poor, sandstone derived soils in central Peru. Both species belong to a group characterized by relatively large flowers, thick twigs, and a well-developed pistillode in the staminate flowers. Some fruiting collections also had flowers; these were always pistillate. One fruiting collection without flowers had a few staminodia left on the margin of the cupule. Because of this I accept that this species has unisexual flowers even though the pistillode in the staminate flowers is well developed. All collections of this species came from altitudes of 3000 m or higher, altitudes where tall trees are an exception.

Ocotea oreophila is known from two localities. In northern Ecuador it occurs in the adjacent cantons of Montúfar and Huaca in the Province Carchi; a single collection is known from the canton Sigchos in the Province Cotopaxi in central Ecuador. In northern Ecuador the forest remnants were found in an area with rich soils and much cultivation of potatoes. Pressure from agriculture was a threat for the forest remnants. A second threat was the cutting of trees for production of charcoal. At the time of the collection of the type specimen, there was a steady stream of packhorses loaded with charcoal coming from the forest. Because *O. oreophila* is a large tree, to 30 m tall with a DBH of 60–80 cm, it is likely to be used for charcoal production. One collector (*Tipaz 13*) noted that wood of *O. oreophila* was used for "tablas, duelas, largueros, leña & carbon." In 1994 a small (10 km^2) reserve was created, the Estacion Biologica Guandera, which includes part of the forest with *O. oreophila*. No information is available from the second locality in Cotopaxi, but it is reasonable to assume that deforestation pressure is similar to the situation in Carchi.

Paratypes. ECUADOR. **Carchi:** ca. 1/2 hr. E of Huaca, past Colonia Huaqueña, 3100–3200 m, 18 Feb. 1989, *H. van der Werff & W. Palacios 10592* (MO, QCNE), *10598* (MO, QCNE), *10600* (MO, QCNE); Cantón Montúfar, Loma El Corazón, al SE de Huaca, 00°35′N, 77°42′W, 3200–3500 m, 26 Mar. 1989, *G. Tipaz 13* (MO, QCNE not seen), *93* (MO, QCNE not seen), 3000 m, 4 Apr. 1991, *W. Palacios, D. Rubio & G. Tipaz 6989* (MO, QCNE not seen); Cantón Huaca, Estacion Biologico Guandera, Loma El Corazón, 00°33′N, 77°43′W, 3080–3680 m, 10 Dec. 1996, *J. Clark 1724* (MO, QCNE not seen). **Cotopaxi:** Cantón Sigchos, en la base de Cerro Azul, 00°36′00″S, 78°50′27″W, 3200 m, 28 July 2003, *J. Ramos, J. Contreras, L. Ramos, A. Tigse & R. Tigse 6697* (CUVC not seen, MO).

21. Ocotea otara van der Werff, sp. nov. TYPE: Colombia. Caldas: Mpio. Villamaria, Playa Larga, 2950 m, *L. M. Renjifo 175* (holotype, MO!). Figure 12.

Ocoteae caesariatae van der Werff affinis, sed ab ea foliis angustioribus, indumento foliorum sparsiore recedit.

Trees, to 25 m. Twigs terete to angular, solid, 7–11 mm diam., densely pubescent, hairs reddish brown, erect and covering the surface entirely but becoming glabrous with age; terminal buds densely pubescent. Leaves alternate, more densely grouped near the tips of the branches, sessile, stiffly chartaceous, narrowly elliptic to lanceolate, 18–36 × 4–7 cm, gradually narrowed to the base, margin flat, apex acute or slightly acuminate, upper surface glabrous or with some pubescence on the midrib, lower surface pale green, moderately to densely pubescent with erect hairs, surface visible between the hairs, ferruginous pubescence denser along the midrib, midrib slightly impressed, secondary veins and tertiary venation immersed and scarcely visible on the upper surface, midrib raised, secondary veins slightly raised and tertiary venation immersed and not visible on the lower surface, secondary veins ca. 12 on each side, but poorly visible, domatia lacking. Inflorescences in the axils of leaves, to 30 cm, paniculate-cymose, densely ferruginous pubescent, hairs erect and covering the surface completely but wearing off in fruiting stage, pedicels to 3 mm, densely pubescent. Staminate flowers pale green, 8 mm diam., tepals spreading to reflexed at anthesis, 3–4 mm, outer surface pubescent, inner surface glabrous but with some fine papillae toward the tip, stamens 9, all 4-locular, outer 6 stamens ca. 2 mm, glabrous, filament 0.5 mm, inner 3 stamens 2.5 mm,

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Ocotea otara v.d Werff
Holotype
Determined by Henk van der Werff 1997
Missouri Botanical Garden 2016
COLOMBIA
LAURACEAE
Ocotea calophylla Mez s.l.
Caldas: Villamaria Municipio
Playa Larga, El buen retiro.
2950 m
Arbol de 9 m, hojas con haz verde oscuro, nervadura principal amarillenta. Envés muy pubescente, pubescencia del raquis ferruginosa menos acentuada en la lámina foliar. Flores verde pálido. Anteras de la primera serie con dos valvas en dos lineas al igual que las de la tercera serie. Hojas hasta de 36 cm de largo y 7 cm de ancho.
Luis Miguel Renjifo 175
MISSOURI BOTANICAL GARDEN HERBARIUM (MO)

Figure 12. Holotype of *Ocotea otara* van der Werff (*L. M. Renjifo 175*, MO).

glabrous, filament 0.8 mm, glands present at the base of the inner stamens, staminodia not seen, pistillode 3.5 mm, shorter than the inner stamens, glabrous, slender, slightly swollen at the base, a small stigma present, receptacle cup-shaped, glabrous inside. Pistillate flowers not known. Fruits not known; cupules shallow, 1.2 cm diam., 0.3 cm deep, pedicel thickened.

Altitudinal range. *Ocotea otara* is found from 2950 to 3100 m.

Etymology. The specific epithet is derived from the Greek "otaros" (large-eared) because of the resemblance of the leaves to large rabbit ears.

Discussion. *Ocotea otara* appears closely related to *O. caesariata* and shares with this species large flowers with spreading tepals, shallow cupules, sessile or subsessile leaves, thick twigs, and the rather dense indument. It differs from *O. caesariata* in having longer, narrower leaves and an indument that does not cover the lower leaf surface completely. Two collections, from Ecuador, Tungurahua, Parque Nacional Llanganates, 2740 m (*Neill et al. 13468*, MO), and Napo, Quijos, Sierra Azul, 2300 m (*Alvarez et al. 389*, MO), are closely related to *O. otara*; they have smaller leaves (to 20 cm long) and a dark brown indument. The labels indicated that the leaves were white beneath, a condition not noted for the specimens of *O. otara*. The Ecuadorian collections probably represent a new species, but staminate flowers are needed for a description; they will be annotated as *Ocotea* aff. *otara* for the time being. Both *Renjifo 175* and *Alvarez 389* had been previously identified as *O. calophylla*, and duplicates may have been distributed under that name.

Paratypes. COLOMBIA. **Caldas:** Mpio. Villamaria, Playa Larga, 3100 m, Oct. 1991, *W. Vargas 425* (MO). **Quindio:** Mpio. Salento, La Marina, 3000 m, June 1996, *W. Vargas 9014* (MO).

22. Ocotea ovalifolia (Ruiz & Pav.) Mez, Jahrb. Königl. Bot. Gart. Berlin 5: 261. 1889. Basionym: *Laurus ovalifolia* Ruiz & Pav., Laurographia, tab. 346. 1813. TYPE: Laurographia, tab. 346 (lectotype, designated here, tab. 346, Ruiz & Pavón, 1813).

Oreodaphne sublanuginosa Nees, Linnaea 21: 515. 1848. *Ocotea sublanuginosa* (Nees) J. F. Macbr., Publ. Field Mus. Nat. Hist., Bot. Ser. 11: 19. 1939. TYPE: Peru, *Ruiz s.n.* (holotype, B!).

Trees, to 25 m. Twigs terete or slightly angular, moderately densely pubescent with erect hairs, surface partially visible, glabrescent with age; terminal buds densely pubescent with short, ascending to erect hairs. Leaves alternate, petiolate, chartaceous, elliptic to slightly obovate, 10–21 × 3–7 cm, gradually narrowed to the base, decurrent on the petiole, base revolute, apex acute or shortly acuminate, upper surface glabrous or sparsely pubescent, major veins densely pubescent, lower surface sparsely to moderately pubescent with erect hairs, surface readily visible, pubescence denser along the major veins, venation immersed on the upper surface, midrib and secondary veins clearly raised, tertiary venation less strongly raised, secondary veins 6 to 9 on each side, domatia as axillary tufts of hairs present at the base of the basal secondary veins, sometimes also along the secondary veins; petioles 1–2 cm, but appearing longer due to the narrow, revolute leaf base, flat above, adaxial surface densely pubescent, lateral and abaxial surfaces sparsely pubescent. Inflorescences in the axils of leaves, those with staminate flowers 10–15 cm, those with pistillate flowers 6–8 cm, paniculate-cymose, sparsely pubescent with erect hairs; pedicels ca. 1 mm, pubescent. Flowers yellow to green, tepals erect at anthesis, becoming spreading in older flowers; staminate flowers 3 mm diam., tepals equal, 1.2 mm, sparsely pubescent on the outer surface, inner tepals more densely pubescent than the outer ones, densely pubescent on the inner surface, stamens 9, all 4-locular, glabrous, or with a few hairs on the filaments, 1.1 mm, anther 0.8 mm, glands present at the base of the inner stamens, staminodia not seen, pistillode glabrous, 1.4 mm, ovary 0.4 mm, globose, receptacle glabrous inside; pistillate flowers with 9 staminodia, these 0.5 mm, filaments 0.1 mm, with a few hairs, pistil 1.5 mm, glabrous, ovary 0.7 mm, stigma raised above the staminodia. Fruits 1.4 × 1.2 cm, cupule a shallow bowl or platelike, 0.7 cm diam., margin entire.

Altitudinal range. *Ocotea ovalifolia* is found from 270 to 1870 m.

Phenology. Flowers have been collected in May, June, and July; fruits in November, January, and February.

Discussion. *Ocotea ovalifolia* is readily recognized by the combination of the following characters: leaf base revolute and decurrent on the petiole, erect pubescence on twigs and leaves, presence of domatia and a denser indument on the adaxial (upper) surface of the petioles than on the abaxial (lower) and lateral surfaces. Rohwer (1986) placed this species in the Ocotea minarum group, a group of about 15 species with gynodioecious flowers and shallow cupules. Most species of this group have domatia, very slender terminal buds, almost round floral buds, and a dense pubescence of the inner surface of the tepals. The inflorescences of *O. ovalifolia* with staminate flowers are on average longer and more widely branched than inflorescences with pistillate flowers. In the staminate flowers the stigma is slightly below the level of the stamens, while in the pistillate flowers the stigma is raised above the level of the staminodia. Six species of the Ocotea minarum group are found in the Andes above 1000 m elevation, *O. crassipedalis*, *O.*

cuneifolia, *O. lenitae*, *O. mandonii*, *O. ovalifolia*, and *O. recurvata*.

Selected specimens examined. ECUADOR. **Napo:** Archidona, Faldas del Volcan Sumaco, *Zak & Jaramillo 3800* (MO). PERU. **Huanuco:** Prov. Puerto Inca, Distr. Yuyapichis, *Tello 1282* (MO). **Junin:** Prov. Satipo, P. Ocopa, *Reynel 236* (MO). **Pasco:** Prov. Oxapampa, 5 km SE of Oxapampa, *Smith 4164* (MO).

23. Ocotea palcazuensis van der Werff, sp. nov. TYPE: Peru. Pasco: Oxapampa, Distr. Palcazu, Parque Nacional Yanachaga–Chemillen, en las nacientes de las quebradas Cashivo y Palmalanbo y naciente del río Lagarto a 3 horas de la comunidad Nativa Alto Lagarto, 10°11′02″S, 75°26′42″W, 1050 m, 20 Sep. 2010, *R. Rojas & G. Ortiz 7494* (holotype, HOXA!; isotypes, B!, MO!). Figure 13.

Ocoteae cinereae van der Werff similis, sed ab ea receptaculo intus glabro, ramulis pubescentibus recedit.

Trees, to 25 m. Twigs terete, densely and finely appressed pubescent, pubescence covering the surface completely, 3 mm diam., solid, terminal buds densely appressed pubescent. Leaves alternate, petiolate, chartaceous, elliptic, 6–10 × 2.5–4 cm, base acute, margin flat, apex acuminate, acumen ca. 1 cm, upper surface glabrous except for some appressed hairs on the midrib, lower surface with few appressed hairs, pubescence denser on the midrib, venation immersed on the upper surface, midrib raised, secondary veins slightly raised and tertiary venation immersed or nearly so on the lower surface, secondary veins 3 to 5 on each side, domatia present as tufts of hairs in the axils of the secondary veins; petioles 5–7 mm, finely appressed pubescent, flat above. Inflorescences 2–3 cm, in the axils of leaves or bracts, moderately appressed pubescent, surface of the inflorescences partially visible, with a few lateral cymes in the lower 1/2, becoming racemose distally; pedicels ca. 1 mm, sparsely appressed pubescent. Staminate flowers 3–4 mm diam., tepals 6, spreading to reflexed, 1 mm, outer surface with a few hairs, inner surface glabrous, stamens 9, all 4-locular, glabrous, outer 6 stamens 1.3 mm, filament as long as the rectangular anther, inner 3 stamens 1.2 mm, filament as long as the anther, 2 glands present at the base of the inner stamens, staminodia IV 0.5 mm, threadlike, pubescent, pistillode threadlike, glabrous or with a few hairs near the base, 1.5 mm, with a small stigma, receptacle moderately deep, densely pubescent inside; pistillate flowers 3–4 mm diam., tepals spreading to reflexed, outer surface glabrous or with a few hairs, inner surface glabrous, staminodia 9, outer 6 staminodia 0.8 mm, inner staminodia 0.6 mm, with 2 glands near the base, staminodia IV 0.5 mm, threadlike, pubescent, receptacle deep, glabrous inside or with some hairs at the base of the staminodia, pistil glabrous, 1.4 mm, style 0.6 mm. Fruits and cupules not known.

Discussion. The combination of unisexual, glabrous flowers, pubescence inside the receptacle, domatia as axillary tufts of hair, flowers with spreading to reflexed tepals, and a stipitiform pistillode sets *Ocotea palcazuensis* apart from its Andean congeners with unisexual flowers. The domatia are small and it is necessary to check several leaves for their presence. The staminodia IV are also small and easily overlooked. With the exception of *O. papyracea* van der Werff, Andean species with unisexual flowers and domatia belong to the Ocotea minarum group, which is characterized by pit domatia, slender terminal buds, pubescent flowers with erect or semi-erect tepals, and a pistillode with a swollen ovary. *Ocotea papyracea* has slit-like domatia along the secondary veins, not axillary tufts of hairs like *O. palcazuensis*. Vegetatively *O. palcazuensis* is similar to *O. cinerea* van der Werff, a species from the Amazonian lowlands. *Ocotea cinerea* differs in the stamens with short filaments (filament half as long as the anther) and sparse pubescence on the twigs. It is likely that once its cupules are known, the relationships of *O. palcazuensis* will be better understood.

Paratype. PERU. **Junin:** Prov. Satipo, Comunidad nativa de Chontaquiari, 56 km de la ciudad de Pichinaki, 1200–1400 m, 6 Nov. 1999, *A. Daza Y. 1525* (MO, MOL not seen).

24. Ocotea papyracea van der Werff, sp. nov. TYPE: Peru. Pasco: Oxapampa, Parque Nacional Yanachaga, El Huampal, 10°11′S, 75°34′W, 1200 m, 1 July 2003, *H. van der Werff, R. Vásquez, B. Gray, R. Ortiz & N. Davila 17916* (holotype, HOXA!; isotypes, HBG!, K!, MO!, NY!, US!). Figure 14.

A congeneris domatiis secus nervos secondarios, foliis papyraceis recedit.

Shrubs or treelets, to 5 m. Twigs terete, sparsely appressed pubescent, soon becoming glabrous, terminal buds slender, densely appressed pubescent, hairs white. Leaves alternate, petiolate, papyraceous, elliptic, 6–11 × 2–4 cm, base acute, margin flat, apex acute or acuminate, acumen to 1 cm, glabrous or with a few appressed hairs on the lower surface, upper

MISSOURI
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0 1 2 3 4 5 6 7 8 9 10
cm
TYPE SPECIMEN
Missouri Botanical Garden (MO)
PERU Isotype
LAURACEAE
Ocotea palcazuensis v.d. Werff
Pasco: Oxapampa
Dist. Palcazu. Parque Nacional Yanachaga-Chemillen; en las nacientes de las quebrada Cashivo y Palmalanbo y naciente del río Lagarto a 3 horas de la comunidad Nativa Alto Lagarto. Remanente de bosque primario.
10°11'02"S 075°26'42"W 1050 m
Arbol 11 m; pétalos cremas.
20 September 2010
Rocío Rojas & G. Ortiz 7494
MISSOURI BOTANICAL GARDEN HERBARIUM (MO)

Figure 13. Isotype of *Ocotea palcazuensis* van der Werff (*R. Rojas & G. Ortiz 7494*, MO).

surface sometimes gland-dotted, midrib and secondary veins slightly raised, tertiary venation ± immersed on both surfaces, secondary veins 3 to 5 on each side, domatia present, slit-like, at branching points of the secondary veins, but not along the midrib; petioles 6–9 mm, slightly canaliculate, glabrous or with a few appressed hairs. Inflorescences 3–6 cm, in the axils of leaves or bracts, paniculate, branches bearing a single cyme, sparsely appressed pubescent, pedicels 1.5–2 mm, sparsely appressed

Figure 14. Isotype of *Ocotea papyracea* van der Werff (*H. van der Werff et al. 17916*, MO).

pubescent. Staminate flowers 2.5–3 mm diam., yellow, tepals 6, half-erect, 1.3 mm, sparsely pubescent outside, more densely so inside, stamens 9, all 4-locular, outer 6 stamens 0.8 mm, filaments 0.2 mm, with a few hairs, inner 3 stamens 0.9 mm, filament 0.3 mm, dorsally pubescent, large globose glands present at the base of the inner stamens, pistillode 1.3 mm, glabrous, ovary round, 0.3 mm, style 1 mm, slender receptacle shallow, glabrous inside; pistillate flowers with 9 staminodia, these 0.5

mm, the locelli rudimentary, glands present at the base of the inner staminodia, ovary almost round, 0.6 mm. Fruits 1.8 × 1.1 cm, cupule a small plate, 5 mm diam., fruiting pedicel thickened, ca. 2 cm.

Altitudinal range. *Ocotea papyracea* is found from 275 to 1200 m.

Phenology. Flowers have been collected between June and September; fruits in January.

Discussion. *Ocotea papyracea* is readily recognized by slit-like domatia along the secondary veins, papery-thin leaves, and few-flowered inflorescences. The staminate flowers can easily be mistaken for bisexual flowers because the pistillode is well developed and round; the style is quite long, in contrast to the pistillate flowers, where the pistil is about twice the size, but with similar shape and a shorter style. The pistillate flowers can be easily recognized because anthers are rudimentary. The stamens are short; even in the staminate flowers they are difficult to see because they are hidden by the half-erect tepals.

Paratypes. PERU. **Pasco:** Oxapampa, Distr. Pozuzo, cercania del Puesto de Control Huampal, 10°10′58″S, 75°34′25″W, 1100 m, 23 July 2006, *A. Monteagudo, J. Mateo & R. Francis 12507* (MO); Pasco, Oxapampa, Distr. Pozuzo, Puesto de control Huampal, 10°11′S, 75°34′W, 1100 m, 13 Aug. 2003, *R. Rojas, J. Lingan, K. Meza, J. Ramon & R. Francis 1320* (MO); Oxapampa, Distr. Palcazu, Reserva Comunal Yanesha, 10°08′04″S, 75°22′06″W, 500 m, 25 July 2008, *R. Rojas & G. Ortiz 5877* (MO); Oxapampa, Distr. Palcazu, Comunidad Nativa Alto Lagarto–Reserva Comunal Yanesha, 10°08′04″S, 75°22′06″W, 500 m, 12 Sep. 2009, *R. Rojas & G. Ortiz 6893* (MO); Oxapampa, Distr. Palcazu, Comunidad Nativa Alto Lagarto, Reserva Comunal Yanesha, 10°09′08″S, 75°23′32″W, 500 m, 30 Jan. 2008, *R. Rojas & G. Ortiz 5271* (MO); Oxapampa, Distr. Pozuzo, Parque Nacional Yanachaga–Chemillen, Sector Huampal, 10°10′59″S, 75°34′17″W, 1210 m, 20 Aug. 2009, *L. Valenzuela & J. Mateo 13437* (MO); Oaxapampa, Distr. Pozuzo, Parque Nacional Yanachaga–Chemillen, puesto Huampal, 10°10′59″S, 75°34′26″W, 1148 m, 9 Aug. 2007, *R. Vásquez, A. Peña, G. Castillo, L. Hernani & D. Vásquez 32612* (MO). **Ucayali:** Coronel Portillo, Distr. Calleria, Cuenca del Rio Utiquinia, Quebrada Espejoyacu, 275–300 m, 26 June 2003, *J. G. Graham 2317* (MO).

25. Ocotea pastazensis van der Werff, sp. nov. TYPE: Ecuador. Pastaza: Parroquia Simón Bolivar, Los Vencedores, 01°30′S, 77°56′W, 1000 m, 12 June 1997, *D. D. Soejarto & J. Caranqui 10032* (holotype, MO!). Figure 15.

Ocoteae caniflorae Mez affinis, sed ab ea foliorum pagina abaxiali trichomatibus erectis praedita recedit.

Trees, to 18 m. Twigs solid, terete or slightly angled, 4–5 mm diam., densely pubescent with short, erect hairs, these covering the surface entirely, terminal buds densely pubescent. Leaves alternate, evenly distributed, petiolate, chartaceous, elliptic to broadly elliptic, 11–20 × 5.5–11 cm, upper surface sparsely pubescent, lower surface moderately pubescent with erect hairs, pubescence denser along the major veins, base and apex acute or obtuse, margin flat or slightly revolute at the base, venation immersed on the upper surface, midrib prominently raised, secondary veins raised and tertiary venation slightly raised on the lower surface, secondary veins 6 to 9 on each side, domatia lacking; petioles 10–15 mm, flat above, densely pubescent. Inflorescences in the axils of leaves, to 7 cm, densely pubescent with short, erect hairs, covering the surface entirely, paniculate-cymose; flowers sessile or with pedicels to 0.5 mm. Staminate flowers not known. Pistillate flowers 6 mm diam., green, moderately pubescent on the outer surface; tepals 6, 2.5 mm, spreading, equal, moderately to sparsely pubescent on the inner surface, staminodia 9, 1.2 mm, filaments as long as the sterile anther, sparsely pubescent, sterile anther glabrous, glands present at the base of staminodia III, staminodia IV not seen, ovary glabrous, 0.7 mm, style 2 mm, 0.4 mm thick, densely pubescent, stigma capitate, a little wider than the style. Fruits almost round, 1.7 × 1.5 mm, sometimes with remnants of the pubescent style apically; cupule 8 mm diam., platelike, with a double margin, frequently the tepals persisting and reflexed.

Altitudinal range. *Ocotea pastazensis* has been collected between 1000 and 1800 m.

Discussion. The densely pubescent style and the flat, platelike cupule with a double margin place *Ocotea pastazensis* in the Ocotea floribunda group of Rohwer (1986). Its closest relative in this group is *O. caniflora* Mez, a poorly known Peruvian species. The main difference between these species is in the indument: *O. pastazensis* has densely pubescent twigs with erect hairs and erect-pubescent lower leaf surfaces, while the flowers are less densely pubescent than in *O. caniflora*; *O. caniflora* has sparsely pubescent twigs with very short hairs and almost glabrous leaves, and if some hairs are present on the leaves, they are appressed. *Ocotea pastazensis* is known only from the flowering holotype and two paratypes collected further south in Ecuador. The paratypes, one fruiting and one sterile, differ from the holotypes in their broader leaves (to 15 cm wide) with an obtuse to rounded apex but agree in their pubescence type. The description of the fruit and

Figure 15. Holotype of *Ocotea pastazensis* van der Werff (*D. D. Soejarto & J. Caranqui 10032*, MO).

cupule is taken from a paratype; otherwise the description is based on the holotype. Two fruiting collections from the Cuzco area in Peru (*Timana 837* and *1058*, both at MO) also belong to the Ocotea floribunda group and are related to *O. pastazensis*; they have an erect indument on the lower leaf surfaces but differ from *O. pastazensis* in having sparsely pubescent twigs, smaller fruits, and leaves with an acute base. Without flowers a further identification of these specimens is not possible.

Paratypes. ECUADOR. **Zamora-Chinchipe:** E border of Podocarpus National Park, Fundacion Maquipucuna, 04°11′S, 78°55′W, 1550 m, 6 Nov. 1996, *J. Clark, P. Conza, P. Walter & M. Zapata 3327* (LOJA not seen, MO, QCNE not seen); Numbala, a 25 km SE de la ciudad de Yangana, 04°31′S, 79°07′W, 1800 m, 25 Aug. 1975, *A. Samaniego & F. Vivar 111* (MO).

26. Ocotea recurvata van der Werff, sp. nov. TYPE: Peru. Amazonas: Distr. Chachapoyas, remnants of forest a few km past Molinapampa, 06°12′S, 77°40′W, 2450 m, 13 Apr. 2001, *H. van der Werff, R. Vásquez, B. Gray & R. Rojas 17007* (holotype, MO!; isotypes, B!, CANB!, F!, HBG!, K!, NY!, P!, US!). Figure 16.

Ocoteae cuneifoliae (Ruiz & Pav.) Mez. affinis, sed ab ea marginibus foliorum recurvatis, venis secundariis valde impressis recedit.

Trees, 15 m. Twigs terete, ridged, 4 mm diam., solid, densely to moderately pubescent with minute, appressed hairs, becoming glabrous with age; terminal buds slender, densely appressed pubescent, surface completely covered. Leaves alternate, petiolate, coriaceous, elliptic, 5–12 × 2–5 cm, base angustate, lamina narrowly decurrent on the petioles, margin recurved, apex bluntly acute, young leaves sparsely appressed pubescent on both surfaces, soon becoming glabrous, midrib and secondary veins strongly impressed, tertiary venation immersed and scarcely visible on the upper surface, midrib and secondary veins prominently raised, tertiary venation immersed on the pale green lower surface, secondary veins 8 to 11 on each side, domatia present as small pits in the axils of the secondary veins, occasionally present along the secondary veins or lacking; petioles 8–12 mm, flat above, with a similar indument as the twigs. Inflorescences in the axils of leaves, paniculate-cymose, moderately to densely appressed pubescent, 5–10 cm; pedicels 1–3 mm, minutely appressed pubescent. Staminate flowers not known. Pistillate flowers green, 4 mm diam., tepals half-erect or spreading in old flowers, 2 mm, outer surface moderately pubescent, inner tepals slightly more pubescent than the outer ones, inner surface of the tepals densely pubescent, staminodia 9, outer 6 staminodia 0.7 mm, filament 0.1 mm, dorsally pubescent as is the base of the anther, inner staminodia 0.9 mm, with a few hairs near the base, glands present at the base of the inner staminodia, staminodia IV absent, pistil 2 mm, ovary gradually narrowed in the style, receptacle cup-shaped, glabrous or with a few hairs near the rim. Fruits 16 × 12 mm, cupule small, 8 mm diam., platelike.

Discussion. *Ocotea recurvata* is readily recognized by the combination of recurved leaf margins, strongly impressed midrib and secondary veins, and the presence of small pit domatia in the axils of the secondary veins and occasionally along the secondary veins. The number of secondary veins is, for the size of the leaves, relatively large. The long, slender terminal buds, the presence of pit domatia, the slightly denser pubescence on the inner tepals than on the outer tepals, and the roundish fruits seated on a small, platelike cupule suggest a placement in the Ocotea minarum group of Rohwer (1986). A recent search for additional collections at or very near the type locality was not successful. Two paratypes do not have the recurved leaf margin but share impressed major veins, presence of pit domatia, and slender terminal buds with the type collection. The old flowers of *Shonle 178* also have the densely pubescent inner surface of the tepals, a character also found in the type collection as well as in other species of the Ocotea minarum group. Two other paratypes lack domatia but have the characteristic leaves with strongly impressed major veins and recurved margins.

Paratypes. ECUADOR. **Zamora-Chinchipe:** Reserva San Francisco, rd. Loja–Zamora, ca. 35 km from Loja, 03°58′S, 79°04′W, 2080 m, 13 Nov. 2008, *N. Cumbicus & J. Peña 683* (MO); Zamora, Limite con Parque Nacional Podocarpus, 04°23′S, 79°05′W, 2500–2600 m, Jan. 1995, *Palacios & Tirado 13145* (MO); Zamora-Huaico, 6 km SE Loja, 2300–2400 m, 3 July 1947, *R. Espinosa 1552* (F). PERU. **Cajamarca:** Prov. Jaen, Distr. Pomahuaca, 06°00′S, 79°15′W, 2350 m, *I. Shonle 178* (MO).

27. Ocotea rufa Mez, Jahrb. Königl. Bot. Gart. Berlin 5: 300. 1889. TYPE: Colombia (Nueva Granada): Andes de Ocaña, 2400 m, *Triana 1057 (= 2054.5)* (holotype, P!; isotypes, K!, NY!).

Shrubs or small trees, to 10 m. Twigs terete, 4–5 mm diam., solid, densely reddish brown tomentose, surface covered by the pubescence, terminal buds densely tomentose. Leaves alternate, petiolate, firmly chartaceous, narrowly elliptic, 10–15 × 3–4 cm, base and apex acute, margin flat, upper surface sparsely pubescent, hairs erect, pubescence denser on the major veins, lower leaf surface moderately to densely pubescent, indument erect, leaf surface visible between the hairs, midrib covered by the pubescence, major veins slightly impressed and tertiary venation immersed and scarcely visible on the upper surface, midrib prominently raised, secondary veins raised and tertiary venation slightly raised on the lower surface, secondary veins 9 to 12 on each side, domatia lacking; petioles 6–10 mm, densely pubescent as the twigs, flat above. Inflorescences in the

Figure 16. Holotype of *Ocotea recurvata* van der Werff (*H. van der Werff et al. 17007*, MO).

axils of leaves, ca. 6 cm, paniculate-cymose, densely reddish brown pubescent, flowers subsessile, pedicels to 1 mm, densely pubescent. Staminate flowers not known. Pistillate flowers ca. 4 mm diam., tepals half-erect, 1.5 mm, outer surface moderately to densely pubescent, inner surface with a few hairs near the base, distally with some small papillae, outer 6 staminodia 0.7 mm, with a few hairs along the filament, inner 3 staminodia 1 mm, with a few hairs on the filament and 2 globose glands at the base,

staminodia IV not seen, pistil glabrous, 1.7 mm, style 0.6 mm, stigma peltate, receptacle cup-shaped, pubescent inside. Fruits ellipsoid, 14 × 6 mm, cupules shallow, 5 mm diam., pedicel swollen.

Distribution and phenology. *Ocotea rufa* is known from three collections in Colombia: the type with pistillate flowers without locality data or collection date and two fruiting collections made in January and February at altitudes from 2300 to 2680 m.

Discussion. *Ocotea rufa* is poorly known and best recognized by its narrowly elliptic leaves, numerous secondary veins, and its reddish brown, erect pubescence. The fruit shape and shallow cupules with swollen pedicels are suggestive of the Ocotea minarum group. Unfortunately, the terminal buds of the three collections seen are damaged, and it is not clear if the terminal buds have the typical shape (long, slender buds) found in the Ocotea minarum group. Once staminate flowers are known, the relationships of *O. rufa* can be more firmly established.

Additional specimens examined. COLOMBIA. **Chocó:** Emisora La Sirena, 3 km W of La Mansa at the top of the Cordillera Occidental, 2300–2400 m, 16 Jan. 1979, *A. Gentry & E. Renteria 24190* (MO); Alto de La Clara, NW of El Carmen, 2680 m, 29 Feb. 1944, *E. Core 316* (US).

28. Ocotea rufotomentella van der Werff, sp. nov. TYPE: Ecuador. Zamora-Chinchipe: Estación Cientifica San Francisco, ca. 30 km from Loja on rd. Loja–Zamora, 03°58′S, 79°04′W, 22 Mar. 2000, *J. Homeier 349* (holotype, MO!; isotype, BIEL not seen). Figure 17.

Primo adspectu *Ocoteae longifoliae* Kunth similis, sed ab ea indumento rufotomentello, basi foliorum recurvata recedit.

Small trees, to 9 m. Twigs 7–9 mm diam., terete to angular, solid or hollow, densely brown to dark reddish brown tomentellous, surface completely covered; terminal buds densely tomentellous. Leaves alternate, sessile, elliptic, firmly chartaceous to coriaceous, 14–22 × 4–6 cm, base revolute, margin otherwise plane, apex acute, upper surface with some crisped hairs when young, especially along the major veins, soon becoming glabrous, lower surface densely tomentellous, indument reddish to dark reddish brown, surface completely covered, midrib and secondary veins immersed, tertiary venation slightly raised and reticulate on the upper surface, midrib and secondary veins raised, tertiary venation raised and reticulate or largely immersed on the lower surface, secondary veins 10 to 14 on each side, domatia lacking. Inflorescences in the axils of leaves, 10–16 cm, densely tomentellous, paniculate-cymose; pedicels ca. 1 mm. Flowers unisexual; staminate flowers 7 mm diam., tepals spreading, 2.5 mm, outer surface tomentellous and surface almost completely covered, inner surface densely tomentellous, surface completely covered, stamens 9, all 4-locular, outer 6 stamens 1.5 mm, anther 1 mm, filament and base of the anther dorsally pubescent, inner 3 stamens 1.5 mm, glabrous, anther 1 mm, 2 glands present at the base of the inner stamens, staminodia not seen, pistillode well-developed, glabrous, 2.2 mm, style 1.2 mm, stigma peltate, receptacle cup-shaped, glabrous inside; young fruits or old pistillate flowers with 9 staminodia, 1 mm, with sometimes 1 or 2 of the locelli opened, but smaller than the anthers in the staminate flowers. Immature fruits enclosed in the hypanthium, tepals persisting on the young cupules; slightly older fruits seated in a cup-shaped cupule without persisting tepals. Mature fruits not known.

Altitudinal range. *Ocotea rufotomentella* is found from 2100 to 2500 m.

Discussion. *Ocotea rufotomentella* is easily recognized by the combination of unisexual flowers, reddish or dark reddish brown pubescence, and sessile leaves with a pronounced inrolled base. In leaf shape it is not unlike *O. longifolia* Kunth, but that species lacks the tomentellous indument and revolute leaf bases. Leaves of *O. longifolia* are distinctly petiolate. Sessile leaves with revolute bases are also found in *O. caesariata*, but that species has a tomentose indument and larger, glabrous stamens. The paratype differs from the holotype in having a darker indument and a less pronounced reticulate tertiary venation. Both collections of *O. rufotomentella* are from the San Francisco scientific station in southern Ecuador. This reserve is uncommonly rich in Lauraceae, possibly because of the intensive collecting in the reserve.

Paratype. ECUADOR. **Zamora-Chinchipe:** Estación Científica San Francisco, 30 km E of Loja on rd. to Zamora, 03°58′35″S, 79°04′14″W, 2100 m, 20 Apr. 2000, *D. Neill & QCNE botany interns 12617* (MO, QCNE not seen).

29. Ocotea rugosa van der Werff, Novon 4: 70. 1994. TYPE: Ecuador. Bolivar: along first 15 km of rd. Chillanes–El Tambo, 2400 m, 18 July 1991, *H. van der Werff, B. Gray & G. Tipas 12429* (holotype, MO!; isotypes, AAU!, GB!, NY!, QCNE!, QRS!, US!).

Small to medium-sized trees, to 15 m, rarely taller. Twigs terete or weakly ridged, solid, 3–4 mm diam.,

Figure 17. Holotype of *Ocotea rufotomentella* van der Werff (*J. Homeier 349*, MO).

tomentellous when young, glabrescent with age; terminal buds densely brown tomentellous. Leaves alternate, petiolate, chartaceous to subcoriaceous, rugose, elliptic to elliptic-obovate, 12–24 × 6–10 cm, base acute or obtuse, margin flat, apex acute or shortly acuminate, upper surface with some hairs when young, hairs denser near the base and along midrib and major secondaries, lower surface with short, erect hairs, these denser along midrib and major secondaries, secondary and tertiary veins

impressed on the upper surface, secondaries becoming loop-connected in the distal 1/2 of the lamina, secondary veins 8 to 11 on each side, domatia lacking; petioles ca. 1 cm, with similar pubescence as the twigs. Inflorescences axillary, to 30 cm, paniculate-cymose, sparsely to moderately pubescent with erect hairs, pedicels 2 mm, moderately pubescent with short, erect or ascending hairs. Flowers green; staminate flowers 5–6 mm diam., tepals spreading, 2 mm, outer surface sparsely pubescent, inner surface glabrous, stamens 9, all 4-locular, glabrous, outer 6 stamens 0.8–1 mm, filament very short, inner 3 stamens 1 mm, subsessile, large glands present at the base of the inner stamens, staminodia not seen, pistillode present, 2 mm, ovary swollen, shorter than the inner stamens, with small stigma, receptacle shallow, glabrous inside; pistillate flowers 4 mm diam., tepals half-erect, staminodia 9, ca. 0.5 mm, glabrous, subsessile, pistil 2 mm, longer than staminodia, glabrous, ovary more swollen and stigma larger than in staminate flowers; glands present at the base of the inner staminodia, receptacle cup-shaped, glabrous inside. Fruits ellipsoid, 14 × 7 mm, pedicel in fruit gradually swollen, cupule small, very shallow to platelike, 7 mm diam., tepals deciduous in fruit.

Altitudinal range. *Ocotea rugosa* is found from 1600 to 2500 m.

Phenology. Flowers have been collected in July and October.

Discussion. *Ocotea rugosa* is similar to *O. velloziana*; differences are the impressed secondary and tertiary veins of *O. rugosa* (immersed in *O. velloziana*) and the ellipsoid fruits (round in *O. velloziana*). The difference in venation would not be sufficient for the recognition of *O. rugosa*, but the combination of the difference in fruit shape and rugose leaves warrants recognition of *O. rugosa*. In addition, the pistillode in the staminate flowers of *O. rugosa* is distinctly swollen at the base whereas the pistillode of *O. velloziana* is slender and not swollen at the base. The two species also differ in their distribution: *O. rugosa* is known from central Ecuador and one fruiting collection from Colombia, while *O. velloziana* has been collected in Venezuela and Colombia and one collection in central Peru. *Ocotea velloziana* is also known outside the Andean region from Brazil, Panama, and Costa Rica.

Selected specimens examined. COLOMBIA. **Nariño:** Reserva Natural La Planada, *Restrepo 435* (MO). ECUADOR. **Bolivar:** along rd. Chillanes–El Tambo, *van der Werff et al. 12436* (MO). **Carchi:** 6 km above Maldonado, *Boyle & Bradford 1933* (MO). **Napo:** Quijos Cantón, Arriba de Baeza, *Palacios 6306* (MO). **Pichincha:** Reserva Floristica–Ecologica Rio Guajalito, *Zak & Jaramillo 595* (MO).

30. Ocotea santamartae van der Werff, sp. nov. TYPE: Colombia. Magdalena: Sierra Nevada de Santa Marta, Finca Los Arroyitos, ca. 10°56′N, 73°58′W, 1800 m, 28 Sep. 1972, *J. Kirkbride Jr. 2232* (holotype, NY!; isotypes, MO!, US!). Figure 18.

Ocoteae micanti Mez similis, sed foliis ramulisque trichomatibus erectis (nec appressis) indutis recedit.

Trees, 8 m. Twigs angular or ridged, 6–7 mm diam., solid, densely tomentose, surface completely covered by the indument, but wearing off with age, terminal buds densely tomentose, completely covered by the pubescence. Leaves alternate, evenly distributed along the twigs, petiolate, chartaceous, elliptic, 11–21 × 4–8 cm, base decurrent on the petiole and revolute, a distinct petiole not evident, apex obtuse, upper surface with a few erect hairs, pubescence denser along the main veins, lower surface densely pubescent with soft, erect hairs with the surface partly visible between the hairs, venation immersed on the upper surface, midrib prominently raised, secondary veins raised and tertiary venation weakly raised on the lower surface, secondary veins 10 to 14 on each side, domatia lacking; petioles not evident due to the decurrent lamina, flat above. Inflorescences in the axils of leaves, paniculate-cymose, 10–14 cm, densely tomentose, surface completely covered, pedicels very short, to 2 mm. Staminate flowers not known. Pistillate flowers white, tepals spreading to reflexed, 2–2.5 mm, outer surface densely pubescent, inner surface proximally with some hairs, distally papillose, staminodia 9, the outer 6 staminodia 1 mm, glabrous filament 0.3 mm, inner 3 staminodia 1.5 mm, with 2 conspicuous glands at the base, staminodia IV not seen, pistil 2 mm, glabrous, style ca. 1.4 mm, glabrous, receptacle cup-shaped, glabrous inside. Immature fruit green, 1.2 × 0.9 cm, cupule cup-shaped, 1 cm wide, 0.4 cm deep.

Discussion. *Ocotea santamartae* resembles *O. micans* but differs in its erect indument (indument of *O. micans* is sericeous), larger inflorescences (inflorescence of *O. micans* is described as "foliis permulto brevior"), sparser indument on the lower leaf surface with the surface largely visible, and different leaf base. In *O. santamartae* the leaf base is revolute and decurrent on the petiole, while in *O. micans* the leaves are nearly sessile and very gradually narrowed to the base. Another presumed relative is *O. caesariata*, which has a denser

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cm
MISSOURI BOTANICAL GARDEN
Ocotea santamartae J Werff
Determined by Henk van der Werff 199
Missouri Botanical Garden
2016
Holotype
120
SA
Ocotea micans Mez vel aff.
Determined by Henk van der Werff 199 6
Missouri Botanical Garden
THE NEW YORK BOTANICAL GARDEN
Plants of Colombia
Departamento del Magdalena
Sierra Nevada de Santa Marta
No. 2232
Fallen tree probably more than 8m tall; petals white, ?anthers cream-color, ovary and fruit green, calyx green. In forest N of finca Los Arroyitos, ca 1800m elev., ca 10° 56'N, 73° 58'W.
J. H. Kirkbride, Jr. 28 September 1972
This specimen initially preserved with formaldehyde.
Field work conducted with the collaboration of the Instituto de Ciencias Naturales de la Universidad Nacional de Colombia, supported in part by funds from the National Science Foundation.
RECORD
NEW YORK BOTANICAL GARDEN

Figure 18. Isotype of *Ocotea santamartae* van der Werff (*J. Kirkbride Jr. 2232*, MO).

indument on the leaves, covering the surface entirely, and coriaceous, not chartaceous, leaves.

31. Ocotea satipensis van der Werff, sp. nov. TYPE: Peru. Junin: Satipo Prov., Gran Pajonal, trail betw. Chequitavo & Kimporquis, 10°45′S, 74°23′W, 1100–1200 m, 31 Mar. 1984, *D. N. Smith 6652* (holotype, MO!; isotypes, HBG!, US!). Figure 19.

Figure 19. Holotype of *Ocotea satipensis* van der Werff (*D. N. Smith 6652*, MO).

Ocoteae dispersae (Nees & Mart.) Mez similis, sed ab ea foliorum pubescentia erecta recedit.

Small trees, 4 m. Twigs 2–3 mm diam., solid, terete, moderately densely pubescent, hairs ascending or appressed, terminal buds densely pubescent, hairs ascending or erect. Leaves alternate, petiolate, chartaceous, elliptic or elliptic-obovate, 6–11 × 3–5 cm, base acute, rarely obtuse, margin flat, apex acute or shortly acuminate, acumen to 5 mm, upper surface

glabrous except for some appressed hairs along the midrib, lower surface moderately pubescent with short, erect hairs, these discernible to the touch, pubescence much denser on the midrib and secondary veins, vernation lines not visible, upper surface smooth or midrib, secondary, and tertiary venation slightly raised, midrib and secondary veins raised, tertiary venation immersed or slightly raised on the lower surface, secondary veins 4 to 6 on each side, domatia lacking; petioles 5–8 mm, terete or flat above, densely pubescent with mostly erect hairs. Inflorescences in the axils of leaves, 3–7 cm, paniculate-cymose, lateral branches with 1 cyme or distally racemose, pedicels ca. 2 mm, sparsely pubescent. Staminate flowers yellow, funnel-shaped, glabrous, 2.5–3 mm diam., tepals 6, equal, erect at anthesis, 1.7 mm, stamens 9, all 4-locular, outer 6 stamens glabrous, 1.3 mm, filament 0.5 mm, inner 3 stamens 1.2 mm, filament 0.3 mm, lower pair of locelli extrorse, upper pair latrorse, glands present at the base of the inner stamens, pistillode 1 mm, stipitiform, glabrous, stigma lacking, receptacle deep, pubescent inside. Pistillate flowers and fruits not known.

Discussion. *Ocotea satipensis* is an inconspicuous species, best recognized by the combination of funnel-shaped, unisexual flowers with erect tepals, stipitiform, glabrous pistillode, erect pubescence on the leaves, small, few-flowered inflorescences, and elliptic to obovate-elliptic leaves with erect pubescence. The presence of a pistillode in staminate flowers and stamens with distinct filaments argue against a relationship with the Ocotea cernua group. When using Rohwer's (1986) key, an affinity with the Ocotea dispersa group is suggested, at least when ignoring the erect pubescence of the leaves. However, the flower shape of *O. dispersa* (Nees & Mart.) Mez does not match the funnel-shaped flowers of *O. satipensis*. In leaf shape and size the two species are fairly similar. The three species in the Ocotea dispersa group occur in Brazil, from Bahia to Paraná, and this distribution also makes a relationship between *O. satipensis* and the Ocotea dispersa group unlikely.

32. Ocotea sericea Kunth, Nov. Gen. Sp. 2 (quarto ed.): 162; (folio ed.): 129. 1817. *Oreodaphne guianensis* (Aubl.) Nees var. *sericea* (Kunth) Meisn., Prodr. [A. P. de Candolle] 15(1): 112. 1864. TYPE: Colombia. In alta planitie Novogranatensi juxta Santa Fé de Bogota, alt. 1370 hex., *Humboldt & Bonpland s.n.* (holotype, P not seen; isotype, B-W not seen).

Trees, 6–17 m. Twigs 4–7 mm diam., angular, solid, densely appressed pubescent, surface completely covered, terminal buds densely sericeous pubescent. Leaves alternate, subsessile or short-petiolate, firmly chartaceous to coriaceous, elliptic, 6–12 × 2.5–4 cm, base acute, angustate or shortly decurrent on the petiole, margin flat or occasionally slightly revolute, apex shortly acuminate, acumen to 5 mm, upper surface glabrous, often lustrous, but basal part of the midrib appressed pubescent, lower surface sericeous, densely appressed pubescent, vernation lines clearly visible, midrib raised, secondary and tertiary venation weakly raised, tertiary venation reticulate, midrib immersed or somewhat raised, secondary and tertiary venation immersed on the lower surface, secondary veins 7 to 10 on each side, poorly visible, domatia lacking; leaves mostly subsessile or petioles to 5 mm, flat above, densely appressed pubescent. Inflorescences in the axils of leaves, 4–7 cm, peduncles flattened, sparsely to densely pubescent, hairs ascending to erect, pedicels to 3 mm, with a similar indument as the peduncles. Flowers unisexual, green or yellowish green; staminate flowers 9 mm diam., tepals spreading at anthesis, 3.5–4 mm, outer surface sparsely pubescent, inner surface glabrous, stamens 9, all 4-locular, outer 6 stamens glabrous, 2.2 mm, filament 0.5 mm, often curved outward, inner 3 stamens erect, glabrous, 2.5 mm, anther 1.5 mm, glands present at the base of the inner stamens, staminodia absent, pistillode glabrous, 3–3.5 mm, ovary swollen, style 1.5 mm, stigma peltate, not reaching the level of the stamens, receptacle cup-shaped, glabrous inside; pistillate flowers 6 mm diam., tepals spreading at anthesis, 3 mm, outer surface pubescent, inner surface sparsely pubescent, outer 6 staminodia glabrous, curved, 1.2 mm, inner 3 staminodia glabrous, straight, 1.5 mm, glands present at the base of the inner staminodia, pistil glabrous, 3 mm, ovary swollen, 1.2 mm, style thicker than in staminate flowers, stigma peltate, well above the level of the staminodia. Fruits ellipsoid, 16 × 9 mm, cupule bowl-shaped, 8 mm diam., margin entire.

Altitudinal range. *Ocotea sericea* is found from 2800 to 3350 m.

Phenology. Flowers have been collected in March, April, and August; fruits in March, August, and September.

Discussion. *Ocotea sericea* can be recognized by the combination of unisexual flowers, sericeous twigs and leaves, the presence of vernation lines on the lower leaf surface, the tertiary venation weakly raised

on the upper surface, and the shortly acuminate leaf tips. The leaves of *O. sericea* are closely spaced and often overlapping. It has been confused with *O. guianensis*, which differs in having an acute (not acuminate) leaf tip and smaller flowers. *Ocotea guianensis* is a common lowland species that has been collected a few times in the Andes but never above 1500 m in altitude, whereas *O. sericea* occurs mostly around 3000 m in altitude. The name *O. sericea* has been applied to several different taxa; some have tomentose (not sericeous) twigs, others lack the acuminate leaf tips, have immersed venation, or have noticeably larger leaves. Images of the types in P and B show relatively small leaves with an acuminate leaf tip, and the protologue mentions that the twigs have a sericeous indument. I therefore feel confident that the name *O. sericea* is correctly applied herein.

Of the fertile collections seen, seven have pistillate flowers, one has staminate flowers, and one collection (*Renjifo 6*, MO) consists of two branches, one with fruits, the other with staminate flowers. The description of the fruits is based on *Renjifo 6*; these fruits were described as purple-black, indicating that they were mature.

Selected specimens examined. COLOMBIA. **Caldas:** Mpio. de Villa Maria, *Vargas 410* (MO). **Cundinamarca:** Reserva Carpanta, *Gentry et al. 71721* (MO). **Putumayo:** *Cuatrecasas 11835* (US). **Quindío:** Reserva del Alto Quindío Acaime, *Renjifo 6* (MO). **Santander:** Mpio de Onzaga, *Jaramillo-Mejia et al. 910* (US). **Valle:** Hoya del río Bugalagrande, *Cuatrecasas 20995* (US). ECUADOR. **Carchi:** along rd. Julio Andrade–El Carmelo–Tulcan, *van der Werff & Gudiño 10978* (MO). **Napo:** Vía Papallacta–Cuyuja, 2700 m, *Palacios & van der Werff 3674* (MO). Provisionally included are two collections from Venezuela, Mérida (*Ruíz-Terán & Dugarte 12436* and *Ruíz-Teráan & Lopez-Palacios 1932*, both MO); they differ in their almost immersed tertiary venation and slightly ascending pubescence of the twigs.

33. Ocotea subparamicola van der Werff, sp. nov. TYPE: Colombia. Antioquia: Mpio. de Medellín, Cerro del Padre Amaya, 06°16′N, 75°41′W, 2860 m, 30 Mar. 1987, *J. L. Zarucchi & B. Echeverry 5124 sheet 1* (holotype, MO!). Figure 20.

Ocoteae sericeae Kunth similis, sed ab ea ramulis trichomatibus arrectis brevibus (nec adpressis) obtectis recedit.

Shrubs or small trees, to 6 m. Twigs terete, 5–7 mm diam., solid, densely pubescent with short, erect hairs, surface completely covered; terminal buds densely pubescent with appressed or ascending hairs. Leaves alternate, sessile, coriaceous or firmly chartaceous, elliptic, 8–12 × 3–4.5 cm, base acute, margin flat, apex with a short acumen, this 3–4 mm, upper surface glabrous, lustrous, except for the pubescent midrib and margin when young, lower leaf surface densely appressed pubescent, sericeous, surface completely covered, vernation lines visible, midrib immersed, secondary and tertiary venation weakly raised on the upper surface, midrib raised, secondary venation slightly raised and tertiary venation immersed on the lower surface, secondary veins 8 to 12 on each side, poorly visible, domatia lacking. Inflorescences in the axils of leaves, 7–13 cm, paniculate-cymose, densely pubescent with erect or ascending hairs, surface completely covered, peduncles to 7 cm; pedicels ca. 2 mm. Flowers pale yellow-green, unisexual; staminate flowers 7–9 mm diam., tepals spreading, 3.5 mm, outer surface densely pubescent, inner surface moderately pubescent, stamens 9, all 4-locular, outer 6 stamens 2 mm, filament 0.7 mm, with a few hairs near the base or glabrous, inner 3 stamens 2 mm, filament 0.7 mm, glands present at the base of the inner stamens, staminodia absent, pistillode glabrous, 2.7 mm, ovary swollen, style 1.7 mm, stigma peltate, not reaching the level of the inner stamens, receptacle cup-shaped, glabrous inside; pistillate flowers 6 mm diam., tepals 2 mm, outer surface pubescent, inner surface sparsely pubescent, staminodia 9, ca. 1 mm, glands present at the base of the inner staminodia, staminodia IV absent, pistil 2.2 mm, glabrous, ovary strongly swollen, 1.5 mm, stigma peltate, raised above the level of the staminodia, fruits ellipsoid, 16 × 10 mm, cupules shallowly bowl-shaped, 10 mm diam., margin entire.

Altitudinal range. *Ocotea subparamicola* is found from 2700 to 3100 m.

Phenology. Flowers have been collected in March and May; fruits in August and September.

Discussion. *Ocotea subparamicola* is easily confused with *O. sericea*. Both species have leaves with a shortly acuminate tip, a sericeous pubescence on the lower leaf surface, weakly raised tertiary venation on the upper surface, sessile or subsessile leaves, large flowers, and thick twigs. The two species differ in the pubescence of the twigs; in *O. subparamicola* the twigs are covered with erect or ascending hairs, while in *O. sericea* the hairs are appressed. The two species also differ in distribution, with *O. subparamicola* known from Antioquia and *O. sericea* from Valle, Quindio, Putumayo, Caldas, and northern Ecuador. *Ocotea guianensis* is more distantly related; it differs in its smaller flowers, narrower leaves with an acute

Figure 20. Holotype of *Ocotea subparamicola* van der Werff (*J. L. Zarucchi & B. Echeverry 5124*, MO).

(not acuminate) tip, smaller fruits seated in a deeper cupule, and presence below 1600 m. All specimens of *O. subparamicola* had been previously identified as *O. sericea* or *O. guianensis* and may be present in other herbaria under these names. The type collection, *Zarucchi & Echeverry 5124*, consists of two sheets at MO, labeled sheet 1 of 2 and sheet 2 of 2. Sheet 1 has staminate flowers and is designated as the holotype. Sheet 2 has pistillate flowers and is a paratype; the description of the pistillate flowers is

taken from this sheet. Whether sheet 1 and sheet 2 were taken from the same individual plant is not known, but unlikely. All Lauraceae with unisexual flowers are dioecious; no monoecious Lauraceae are known. Duplicate specimens may have been distributed to other herbaria. Of the duplicates, the specimens with staminate flowers are isotypes and specimens with pistillate flowers are paratypes.

Paratypes. COLOMBIA. **Antioquia:** Mpio. de Medellin, Cerro del Padre Amaya, 2990 m, 18 Mar. 1987, *Zarucchi & Madrigal 4820* (MO); Cerro del Padre Amaya, 30 Mar 1987, *Zarucchi & Echeverry 5124 sheet 2* (MO); along rd. to Cerro del Padre Amaya, 2970 m, 15 Sep. 1987, *Zarucchi & Brant 5301* (MO); Mpio. Bello, Cerro San Félix, 3000–3100 m, 22 May 1991, *Fonnegra & Curso Taxonomía Vegetal 3722* (MO); Alto Robletita above Sonson, via Sonson–Rio Sirgua camino, 2740 m, 26–28 May 1944, *Ewan 15750* (US); Páramo de Sonsón, 2700–2850 m, Dec. 1943, *Bro. Daniel 3466* (US); Mpio Sonsón, ascenso al Cerro "La Paloma," 2900–3000 m, 18 Aug. 1992, *Callejas & Roldán 10604* (MO).

34. Ocotea tarmensis van der Werff, sp. nov. TYPE: Peru. Junin: Distr. Tarma, Km. 35 de Tarma a la Merced, Huacapintana, 11°18′37″S, 75°33′13″W, 2672 m, 13 July 2008, *R. Vásquez M., G. A. Castillo, R. Rivera & C. Rojas 34488* (holotype, HOXA!; isotypes, HBG!, MO!, NY!, P!). Figure 21.

Ocoteae tenellae A. C. Sm. affinis, sed ab ea floribus majoribus, foliis longioribus latioribusque recedit.

Treelets, 4 m. Twigs terete or slightly angular, solid, 3 mm diam., moderately to densely pubescent with soft, white hairs, these erect or ascending, surface not completely covered; terminal buds densely pubescent with erect to ascending hairs. Leaves alternate, petiolate, chartaceous, elliptic to broadly elliptic, 9–15 × 4–7 cm, base acute to obtuse, margin flat, apex acute or acuminate, acumen to 1 cm, upper surface glabrous, with numerous small gland dots, lower surface moderately pubescent with short, whitish erect hairs, these discernible to the touch but inconspicuous, pubescence denser along the major veins, midrib slightly raised, secondary and tertiary venation immersed on the upper surface, midrib and secondary veins raised, tertiary venation slightly raised on the lower surface, secondary veins 5 to 7 on each side, curving upward and slightly loop-connected near the margin, domatia lacking; petioles 7–10 mm, flat above, with a similar indument as the twigs. Inflorescences in the axils of leaves, 6–13 cm, paniculate-cymose, moderately pubescent near the base, becoming glabrous distally, main axis slightly zigzag, lateral branches under an angle of 90° or somewhat curved back, pedicels distinct, 2–3 mm, glabrous. Staminate flowers greenish, 3–4 mm diam., 2 mm high, bowl-shaped, glabrous, tepals 6, glabrous on both surfaces, half-erect, 1.5 mm, stamens 9, all 4-locular, glabrous, outer 6 stamens with sessile anthers, 0.8 mm, inner 3 stamens 1 mm, filament 0.5 mm, ca. as wide as the anther, small glands present at the base of the inner stamens, pistillode not seen, receptacle shallow, pubescent inside. Pistillate flowers and fruits not known.

Discussion. The lack of a pistillode, the lack of filaments of the outer stamens, the pubescent receptacle, and the glabrous flowers place *Ocotea tarmensis* in the Ocotea cernua group of Rohwer (1986). The most common species in this group, *O. cernua* (Nees) Mez and *O. spectabilis* (Meisn.) Mez, are glabrous and occur in lowland forests of South America. *Ocotea cernua* has occasionally been collected at higher altitudes (1700 m) in the Andes of Ecuador and Peru, but such specimens are glabrous. Two species in this group, *O. tenella* A. C. Sm. from Acre, Brazil, and *O. villosa* Kosterm. from southern Brazil, have relatively dense pubescence on the twigs and erect pubescence on the lower leaf surface. These species, though, have smaller flowers (2 mm diam. vs. 3–4 mm diam.) and smaller leaves. Thus, *O. tarmensis* is here recognized as a distinct species based on its larger flowers and pubescent leaves and twigs. It also occurs at much higher altitudes than the montane populations of *O. cernua*. Although the type locality is along the main road from Lima to the department of Pasco, there are few collections from this area.

35. Ocotea velloziana (Meisn.) Mez, Jahrb. Königl. Bot. Gart. Berlin 5: 347. 1889. Basionym: *Oreodaphne velloziana* Meisn., Prodr. [A. P. de Candolle] 15(1): 132. 1864. TYPE: Brazil. Ca. Rio de Janeiro, *Riedel 1313* (holotype, LE not seen; isotype, NY!).

Ocotea babosa C. K. Allen, Mem. New York Bot. Gard. 15: 82. 1966. TYPE: Venezuela. Estado Merida: La Mucuy, 2200–2400 m, *L. Bernardi 86* (holotype, NY!).

Trees, to 15 m, rarely to 25 m. Twigs angular, 5–7 mm diam., solid, moderately to sparsely pubescent with white, erect hairs, terminal buds densely pubescent with erect hairs. Leaves alternate, petiolate, firmly chartaceous, elliptic to broadly elliptic or ovate, 8–20 × 5–11 cm, base acute to rounded, margin flat, rarely somewhat revolute near the base, apex acute to rounded, upper surface often lustrous, sparsely appressed pubescent or glabrous, pubescence denser along the major veins, lower surface

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TYPE SPECIMEN
Missouri Botanical Garden (MO)
PERU Isotype
LAURACEAE
Ocotea tarmensis Vd Werff
Junin: Tarma
Dist. Tarma. Km. 35 de Tarma a la Merced. Huacapintana. Bosque en borde de carretera.
11°18'37"S 075°33'13"W 2672 m
Arbolito 4 m; flores verdosas.
13 July 2008
Rodolfo Vásquez M., Gina Angela Castillo, R. Rivera & César Rojas 34488
MISSOURI BOTANICAL GARDEN HERBARIUM (MO)

Figure 21. Isotype of *Ocotea tarmensis* van der Werff (*R. Vásquez et al. 34488*, MO).

sparsely to densely pubescent, hairs erect, straight or curly, major veins more densely pubescent, venation immersed on the upper surface, midrib prominently raised, secondary and tertiary venation raised on the lower surface, secondary veins 6 to 9 on each side, domatia lacking; petioles 8–20 mm, flat above, with a similar indument as the twigs. Inflorescences in the axils of leaves, 5–14 cm, paniculate-cymose, moderately to densely pubescent with predominantly erect hairs, pedicels 1–3 mm or flowers nearly sessile,

pubescent with erect hairs. Flowers greenish yellow; staminate flowers 4–6 mm diam., tepals half-erect to spreading, tepals 6, 2–2.5 mm, glabrous or nearly so on the outer surface, outer 6 stamens 1.5 mm, glabrous, filament 0.3 mm, inner 3 stamens 1.8 mm, glabrous, filament 0.5 mm, glands present at the base of the inner stamens, staminodia IV 0.5 mm, columnar, glabrous, pistillode 2 mm, glabrous, slender, stigma present, receptacle cup-shaped, sparsely pubescent inside; pistillate flowers with tepals erect to half-erect, 3.5 mm diam., tepals 6, 2–2.5 mm, outer surface glabrous or sparsely pubescent, outer 6 staminodia 0.6 mm, glabrous, inner 3 staminodia 1 mm, glabrous, with 2 glands at the base of the filaments, staminodia IV not seen, pistil 2 mm, glabrous, ovary 1 mm in diam., stigma capitate, receptacle shallowly cup-shaped, glabrous inside. Fruits round, 1 cm diam., cupule shallow, almost platelike, to 1 cm diam., margin undulate, simple; tepals deciduous in fruit, sometimes partly persisting; pedicels swollen in fruit.

Distribution. *Ocotea velloziana* is known from Colombia, Venezuela, and Peru at altitudes from 1200 to 2900 m. One collection from outside the Andes (Estado Miranda, Venezuela, 600 m) is also placed here. Outside the Andean region it is known from Panama, Costa Rica, and southern Brazil.

Phenology. Flowering specimens have been collected in January, February, March, and December; fruiting collections throughout the year.

Vernacular name. Laurel baboso (several collections from Venezuela), alluding to the ample mucilage in its bark.

Discussion. *Ocotea velloziana* can be recognized by the combination of unisexual, glabrous or almost glabrous flowers, erect pubescence on twigs, leaves, and inflorescences, shallow to platelike cupules with an undulating margin, and round fruits. The Peruvian collection has a denser indument on the leaves and on the inside of the receptacle. Mez (1889) applied the name *O. macropoda* (Kunth) Mez to this species, and I followed this usage in my treatment of *Ocotea* for Central America (van der Werff, 2002). However, the description of *Persea macropoda* Kunth states that the twigs and leaves are glabrous, and the image of the holotype in P shows that it is indeed glabrous. Rohwer (1986) noticed the confusion and considered *O. macropoda* sensu typi a likely synonym of *O. puberula* (Rich.) Nees, a widely distributed lowland species, and treated *O. macropoda* sensu Mez as a synonym of *O. velloziana*. After studying an isotype of *O. velloziana* and comparing staminate flowers from specimens from southern Brazil (*Jardim 3053* and *Silva 4807*, both at MO) and Venezuela (*Parra 65*, MO), I found no differences between the specimens from southern Brazil and Venezuela/Colombia. I concur with Rohwer and accept *O. velloziana* as the correct name for this species. Mez (1889) cited few collections from Rio de Janeiro as *O. velloziana* but cited several collections from São Paulo, Goiás, and other locations in southern Brazil as *O. macropoda* sensu Mez as well as few collections from Colombia and one from Peru. Mez was aware of the similarity between *O. velloziana* and *O. macropoda* sensu Mez and noted after his description of *O. velloziana* that it was scarcely different in leaf shape from *O. macropoda* sensu Mez and possibly not more than a variety of that species. The distribution of *O. velloziana* is unusual in Lauraceae, with one center in southern Brazil and a second one in Venezuela, Colombia, Panama, and Costa Rica. It is not unique, though; *Nectandra oppositifolia* Nees & Mart. has a similar distribution. Another species related to *O. velloziana* is known from two fruiting collections from 1200 and 2100 m in altitude in Pasco, Peru; it differs in having a denser pubescence, larger, broader leaves, smaller cupules, and revolute leaf bases. Unfortunately, flowers of this species are unknown, and without flowers, further identification is not possible. Additional studies are necessary to determine the relationships of this Andean species to *O. velloziana* and its allies.

Selected specimens examined. COLOMBIA. **Antioquia:** Mpio. Carmen de Viboral, *Callejas et al. 10186* (MO). **Cundinamarca:** Laguna Pedro Palo above Finca San Jose, *Gentry & Fallen 17132* (MO). **Quindio:** Mpio. de Armenia, *Vargas 14412* (MO). **Risaralda:** La Pastora, Reserva Ucumari, *Rangel 5642* (MO). **Valle:** Finca Zungara, 6 km N of Cali–Buenaventura hwy., *Gentry et al. 53533* (MO). PERU. **Junin:** Satipo Prov., Gran Pajonal, *Smith 6634* (MO). VENEZUELA. **Guárico:** Distr. Roscio, Monumento Natural Cerro Platillón, *Meier & Elsner 6156* (MO). **Merida:** San Eusebio, carretera Merida–Azulita, *van der Werff et al. 8789* (MO). **Miranda:** Parque Nacional de Guatopo, *Gentry & Troth 24827* (MO).

Imperfectly Known Species

Persea grandis Mez, Jahrb. Königl. Bot. Gart. Berlin 5: 160. 1889, nom. illeg., non (Nees) Nees, Pl. Asiat. Rar. 3: 32. 1832. TYPE: Bolivia. Sandillani, *Pearce s.n.* (K!, 2 sheets).

The type collection of *Persea grandis* Mez consists of two sheets, one with two leaves and detached infructescences, the other with a twig with attached leaves and a detached infructescence. The description of the flowers (Mez mentioned "flores subde-

florati") clearly points to *Persea* Mill.—outer three tepals shorter than the inner three and staminodia large with a sagittate apex. Mez also mentioned that the general habit resembled *Ocotea karsteniana* Mez. and *O. umbrosa* Kunth. Kopp (1966) excluded *P. grandis* from *Persea* and considered it a species of *Ocotea*; she annotated the type in 1957 as "probably *Ocotea*." Kostermans annotated the type in 1962 as "certainly a *Persea*." I agree with Kostermans that the detached infructescences are likely *Persea*. However, the twig with leaves does not appear to be a *Persea*. Most *Persea* species have a well-developed petiole; relatively long petioles are a vegetative character of *Persea*. Only two species, *P. sessilis* Standley & Steyerm. and *P. pajonalis* van der Werff, have sessile or subsessile leaves. Both species have the leaf base abruptly rounded, not gradually narrowed in the petiole. The twig with leaves has several characters pointing to the Ocotea smithiana group, such as thick (1 cm diam.) twigs with pale bark and sessile leaves gradually narrowed to the base and with a revolute margin. The twig with leaves is very similar to *O. kolera* from central Peru. Two recent sterile collections from Bolivia, Parque Nacional Madidi (*Araujo-Murakami et al. 3556* and *3617*, MO) are the same species as the leafy twig collected by Pearce. *Ocotea kolera* has fruits seated in a bowl-shaped cupule without persistent tepals. The detached infructescences collected by Pearce show typical *Persea* characteristics—absence of a cupule and presence of persistent tepals at the base of the fruits. My interpretation of the Pearce type collection of *P. grandis* Mez is as follows: The twig and leaves belong to an *Ocotea* species closely related to *O. kolera*, and the detached infructescences belong to a *Persea* species. The name *P. grandis* Mez cannot be used for the infructescences because it is a later homonym of *P. grandis* (Nees) Nees.

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Van der Werff, H. 2014. Studies in Andean *Ocotea* (Lauraceae) III. Species with hermaphroditic flowers and moderately pubescent or glabrous leaves occurring above 1000 m in altitude. Novon 23: 336–380.

Appendix 1.

List of accepted names and exsiccatae examined. Collections are listed alphabetically by collector with type collections in boldface. The numbers in parentheses correspond to the numbers of the species in the list of accepted species.

1. *Ocotea adusta* van der Werff
2. *Ocotea alnifolia* (Meisn.) Mez
3. *Ocotea antioquiensis* van der Werff
4. *Ocotea aquila* van der Werff
5. *Ocotea arenaria* van der Werff
6. *Ocotea argyrea* van der Werff
7. *Ocotea bofo* Kunth
8. *Ocotea caesariata* van der Werff
9. *Ocotea carchiensis* van der Werff

10. *Ocotea crassipedalis* van der Werff
11. *Ocotea crinita* van der Werff
12. *Ocotea cuneifolia* (Ruiz & Pav.) Mez
13. *Ocotea euryphylla* van der Werff
14. *Ocotea guianensis* Aubl.
15. *Ocotea kolera* van der Werff
16. *Ocotea lenitae* van der Werff
17. *Ocotea mandonii* Mez
18. *Ocotea megistophylla* van der Werff
19. *Ocotea micans* Mez
20. *Ocotea oreophila* van der Werff
21. *Ocotea otara* van der Werff
22. *Ocotea ovalifolia* (Ruiz & Pav.) Mez
23. *Ocotea palcazuensis* van der Werff
24. *Ocotea papyracea* van der Werff
25. *Ocotea pastazensis* van der Werff
26. *Ocotea recurvata* van der Werff
27. *Ocotea rufa* Mez
28. *Ocotea rufotomentella* van der Werff
29. *Ocotea rugosa* van der Werff
30. *Ocotea santamartae* van der Werff
31. *Ocotea satipensis* van der Werff
32. *Ocotea sericea* Kunth
33. *Ocotea subparamicola* van der Werff
34. *Ocotea tarmensis* van der Werff
35. *Ocotea velloziana* (Meisn.) Mez

Acosta Solis ***13350*** (9); *Alston 7230* (8); *Altamirano 1841* (17); *Alvarez 98* (12), *389* (aff. 21); *Araujo-M. 2515* (7); *Aulestia 2273* (22), *3378* (22).

Barclay 10295 (8); *Bernardi 11033* (8); *Berry 3415* (8), *3809* (8); *Betancur 6924* (8); *Boyle 1933* (29), *2180* (29), *2208* (29), *3338* (8), *3456* (8); *Breteler 4624* (aff. 19); *Briceño 726* (11).

Callejas 2304 (14), *7973* (14), *10186* (35), *10604* (33); *Campos 2402* (7), *3813* (12), *4766* (7), *6431* (12), *6601* (17 s.l.); *Cardenas 3262* (3); *Cerón* ***901*** (1); *Clark 1724* (20), *3327* (25); *Core 316* (27); *Cuadros 3700* (8); *Cuamacas 151* (1); *Cuatrecasas 10277* (8), *11835* (32), *12735* (8), *19174* (aff. 19), *21652* (19), *22476* (19), *23506* (aff. 19), *27402* (9); *Cuello 2460* (8), *2479* (aff. 19); *Cumbicus 683* (26).

Daly 5073 (35); *Davidse 19586* (8); *Dawe 800* (8); *Daza 1525* (23); *Devia 930* (35); *Diaz 3553* (7), *4354* (15), *8714* (12); *Duno 816* (8).

Espinosa 1552 (26); *Ewan 15750* (33).

Flores 165 (7); *Fonnegra 3722* (33); *Fuentes 15335* (7).

Garcia-Barriga 17685 (aff. 19), *20740* (8); *Gentry 17132* (35), *24190* (27), *53165* (35), *53227* (35), *53249* (35), *53533* (35), *64130* (22), *71721* (32); *Godoy 136* (22); *Goudot* ***s.n.*** (2); *Graham 2317* (24); *Grijalva 554* (12).

Holm-Nielsen 6965 (12); *Homeier 348* (17 s.l.), ***349*** (28), *1637* (12); *Huamantupa 16029* (18); *Huertos 1049* (19).

Idrobo 850 (14).

Jaramillo-Mejia 832 (33), *910* (32); *Jervise* ***s.n.*** (8).

Killip 15172 (14), *18153* (8); *Kirkbride* ***2232*** (30).

Leiva 1778 (17 s.l.); *León 2154* (aff. 15); *Little 106* (12), *134* (12).

Madriñan 730 (32), *736* (aff. 8), *742* (1); *Mandon* ***1043*** (17); *Marcano Berti 815* (aff. 19); *McPherson* ***13269*** (3); *Melampy 1266* (8); *Monteagudo 4005* (22), *7022* (11), *7244* (11), *7453* (11), *8079* (11), *8600* (18), *12507* (24), *12574* (16), *12590* (16), *12901* (11), ***12924*** (15); *Morales* ***1839*** (4); *Mutis 1412* (32), *1432* (32), *2918* (19).

Neill 10341 (12), *12617* (28), ***13061*** (13), *13167* (13), *13468* (aff. 21), *16632* (12).

Ortiz 1191 (7), *1193* (7), *1255* (7).

Palacios 2154 (12), *3674* (32), *4850* (12), *4964* (12), *4972* (12), *4978* (12), *5014* (12), *5019* (12), *6286* (12), *6292* (12), *6306* (29), *6350* (12), *6989* (20), *7278* (29), *10039* (12), *12552* (8), *13145* (26); *Paniagua* ***8718*** (10); *Parra 60* (35), *65* (35); *Pennington 16812* (7); *Perea 443* (22), *2336* (18), ***3078*** (18), *4216* (22), *4229* (22), *4365* (22); *Perez 5274* (1), *6211* (1); *Philipson 1882* (14).

Quelal 52 (29); *Quizhpe 1288* (12), *1335* (12).

Ramos 6697 (20); *Rangel 5642* (35); *Renjifo 6* (32), *83* (aff. 8), *95* (1), ***175*** (21); *Restrepo 435* (29); *Reyes 1165* (4); *Reynel 236* (22); *Riedel* ***1313*** (35); *Riina 918* (8); *Rojas 1200* (22), *1320* (24), *2573* (22), *5271* (24), *5877* (24), *6893* (24), ***7494*** (23); *Rubio 597* (12); *Ruiz Teran 462* (32), *962* (8), *1278* (35), *1932* (32), *12436* (32), *13440* (8), *14828* (35); *Ruiz & Pavón s.n.* (22), *s.n.* (12).

Sagástegui 15322 (17 s.l.), *15425* (17 s.l.), *15506* (17 s.l.); *Salinas 2719* (17); *Samaniego 111* (25); *Sanchez 1355* (35); *Sanchez-Vega 9557* (12), *9982* (12); *Schiefer 428* (8); *Schultes 4053A* (8), *7002A* (8); *Shonle 178* (26); *Silverstone-Sopkin* ***2897*** (6); *Smith 2797* (22), *3167* (22), *4164* (22), *4169* (22), *4829* (17 s.l.), *4910* (15), ***6652*** (31); *Sobel 2137* (35); *Soejarto* ***10032*** (25); *Solomon 17466* (17); *Stein 2760* (12), *3612* (8); *Steyermark 56629* (35), *96732* (aff. 2); *Suclli 1165* (7), *1245* (7).

Tipaz 13 (20), *93* (20), *1826* (12); *Tomas 1570* (aff. 19), *s.n.* (aff. 19); *Triana 1055 = 2054.3* (32), ***1056 (= 2054.4)*** (19), ***1057 (= 2054.5)*** (27).

Valencia 2477 (12), *2636* (12); *Valenzuela 7319* (12), *9053* (17 s.l.), *10263* (12), *13437* (24), *13953* (22), *19286* (12), *19646* (12); *Vargas 410* (32), *425* (21), *1208* (32), *4525* (19), *8879* (35), *9014* (21), *14227* (35), *14412* (35); *E. Vásquez 169* (22); *R. Vásquez 25158* (aff. 7), *27876* (22), *28720* (11), *30191* (11), *30210* (11), *32612* (24), ***34488*** (34), *35734* (22), *36144* (916); *Villa 816* (22).

Weberbauer 7155 (17); *van der Werff 8228* (35), *8335* (22), *8353* (22), *8764* (35), *8783* (35), *8789* (35), *8790* (35), *8993* (2), *8994* (2), *9101* (2), *9434* (2), *9438* (2), *9439* (17 s.l.), *9451* (17 s.l.), ***10601*** (20), *10573* (12), *10592* (20), *10598* (20), *10600* (20), *10949* (1), *12216* (29), *12279* (12), ***12429*** (29), *12436* (29), *12496* (29), *13366* (29), *13413* (12), *14838* (5), ***14941*** (5), *16510* (16), *16545* (16), ***16546*** (16), *16987* (22), ***17007*** (26), *17597* (11), *17792* (22), *17828* (22), *17831* (22), *17837* (22), *17885* (22), ***17916*** (24), *18467* (22), *19737* (11), *22865* (15), *22936* (11), ***23044*** (11), *23125* (11), *23156* (11), *25106* (12); *Woytkowski 6836* (7).

Young 1423 (aff. 15).

Zak 595 (29), *3800* (22); *Zarucchi 4820* (33), ***5124*** (33), *5301* (33).

Nototriche chaniensis (Malvaceae), una Nueva Especie Poligámica de los Andes de la Argentina

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Resumen. Se describe e ilustra a *Nototriche chaniensis* C. A. Zanotti & J. C. Ospina (Malvaceae), una nueva especie poligámica de los Andes de la Argentina. *Nototriche chaniensis* es morfológicamente afín a *N. agyna* Krapov., de la cual se diferencia principalmente por presentar el lóbulo central de la lámina entero, y la vagina y la porción libre del pecíolo de la hoja son de un largo considerablemente menor. Se incluyen la descripción, ilustración y fotos de la especie nueva. Se presenta una clave para diferenciar las especies poligámicas conocidas hasta el momento.

Abstract. We describe and illustrate *Nototriche chaniensis* C. A. Zanotti & J. C. Ospina (Malvaceae), a new Andean polygamous species of Argentina. *Nototriche chaniensis* is morphologically related to *N. agyna* Krapov., from which it differs mainly by having the central lobe of the blade entire, and the stipular sheath and free portion of the leaf petiole considerably shorter. A description, illustration, photos of the new species, and a key to differentiate the polygamous species are provided.

Key words: Argentina, *Nototriche*, polygamy, southern Andes.

Nototriche Turcz. (Malvaceae) incluye alrededor de 110 especies neotropicales andinas que se distribuyen desde Ecuador hasta la Argentina y Chile, entre los 3500 y 5700 m.s.n.m. Este género se caracteriza por presentar una vagina protectora formada por la unión de las estípulas y el pecíolo de la hoja, y por presentar el pedúnculo floral fusionado al pecíolo (Hill, 1909; Krapovickas, 1951; Fryxell, 1997; Gonzáles et al., 2015). Si bien, la ausencia de epicáliz fue considerado como un carácter diagnóstico (Hill, 1909; Fryxell, 1997; Bayer & Kubitzki, 2003), esta estructura se encuentra en las especies anuales de *Nototriche* (Krapovickas, 1951, 1953; Marticorena, 2005).

Hill (1909) realizó la revisión taxonómica para el género y reconoció 62 taxones. Krapovickas (1953) realizó una clave provisional para las especies de *Nototriche* presentes en la Argentina y posteriormente, estudió las especies polígamas de este género (Krapovickas, 1957). Aunque los taxones de *Nototriche* han sido tratados en floras regionales (Krapovickas, 2003; Marticorena, 2005) o en catálogos florísticos (Jørgensen & Fryxell, 1999; Chanco et al., 2007; Krapovickas, 2008; Alverson, 2014), actualmente los estudios taxonómicos para este género son escasos.

La mayor parte de las especies de *Nototriche* son plantas monoclino-monoicas; sin embargo, Hill (1909), al momento de describir dos especies para Perú (*N. azorella* A. W. Hill y *N. congesta* A. W. Hill), observó ejemplares que poseían flores únicamente masculinas. Por otra parte, Krapovickas (1953), observó ejemplares con plantas que llevaban flores exclusivamente masculinas y plantas con flores completas con las anteras abortadas al describir a *N. cajonensis* para la Argentina, confirmando así, la condición de dioecia (poligamia) en algunas especies de *Nototriche*. Finalmente, Krapovickas (1957), reportó cuatro nuevas especies polígamas, aumentando a siete el número de taxones que reúnen esta condición de importancia taxonómica dentro del género.

Durante un viaje de colección a las serranías del Chañi (Jujuy, Argentina) se colectaron especímenes de *Nototriche* con flores polígamas. Este taxón, nuevo para la ciencia, se describe e ilustra, y además, se brinda una clave para la identificación de las especies afines. Se revisaron los protólogos y las imágenes digitales de los ejemplares tipo de todas las especies polígamas conocidas hasta el momento.

Nototriche chaniensis C. A. Zanotti & J. C. Ospina, sp. nov. TIPO. Argentina. Jujuy: Depto. Dr. Manuel Belgrano, desde el Refugio Militar al Chañi, ca. 500 m del refugio, 24°02′13″S, 65°42′58″W, 4610 m.s.n.m., 28 ene. 2012, *C. A. Zanotti & M. Suescún 279* (holotipo, SI 091772!; isotipo, CTES!). Figuras 1, 2.

Diagnosis. *Nototriche chaniensis* C. A. Zanotti & J. C. Ospina differs from *N. agyna* Krapov. by having the central lobe of the leaf blade entire and the free portion of the petiole and the stipular sheath shorter.

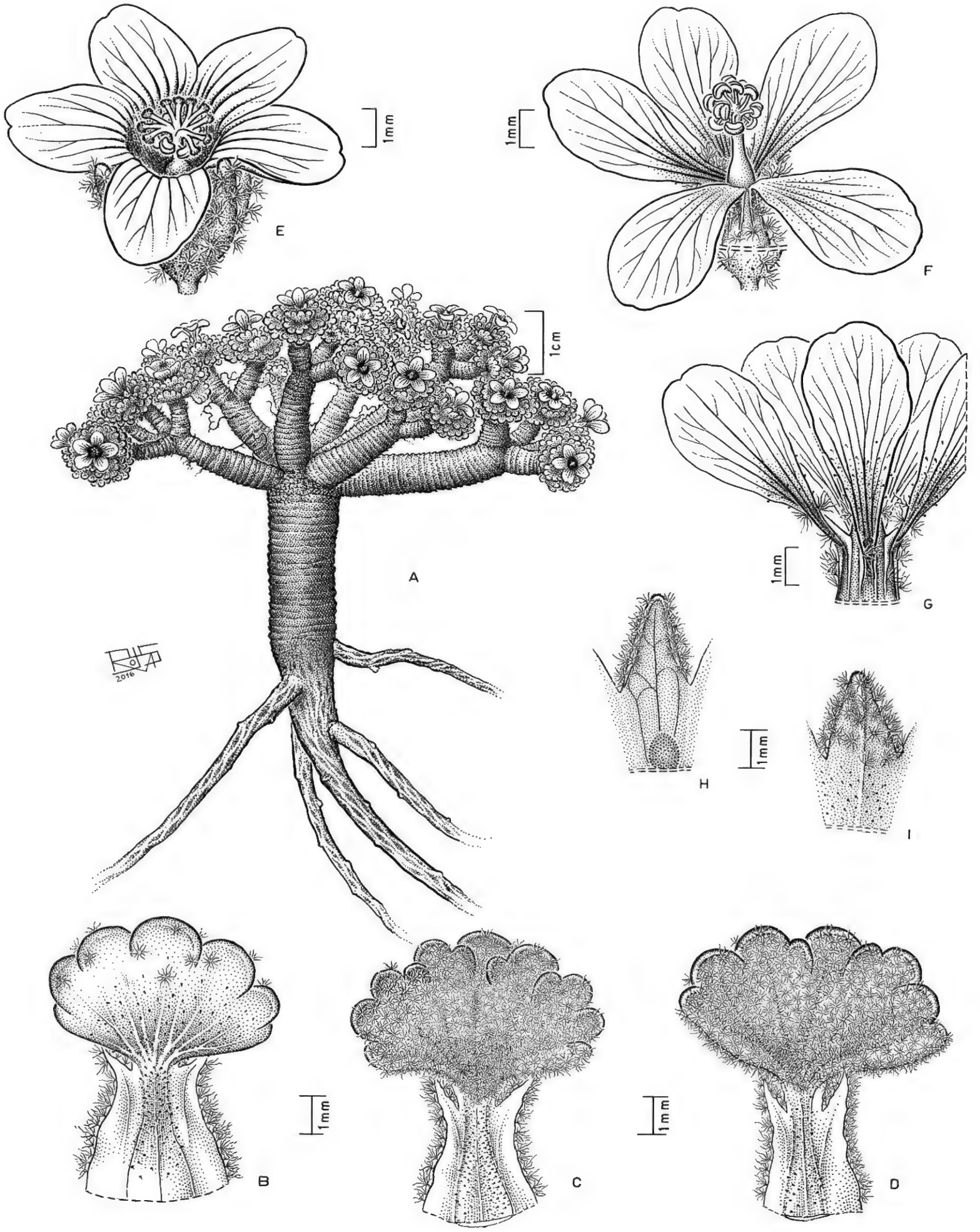

Figura 1. *Nototriche chaniensis* C. A. Zanotti & J. C. Ospina. —A. Hábito. —B. Hoja 5-lobada, hipofilo. —C. Hoja 9-lobada, epifilo. —D. Hoja 7-lobada, epifilo. —E. Flor perfecta. —F. Flor masculina, detalle del tubo de la corola. —G. Pétalos y tubo de la corola. —H. Lóbulo del cáliz mostrando el nectario, vista ventral. —I. Lóbulo del cáliz, vista dorsal. Dibujo del holotipo *C. A. Zanotti & M. Suescún 279* (SI).

Hierba perenne, polígama, arrosetada, formando pequeños cojines. Tallos subterráneos de 2–5 cm de largo, ramificados. Láminas de 3–3.5 × 4–6 mm, crasas, plegadas, flabeladas, con (5)7(9) lóbulos redondeados, enteros, a excepción del primer o segundo par de lóbulos contiguos al medial que pueden presentar un lobulillo en la parte superior; base de la lámina cuneada, con tricomas estrellados en el margen; epifilo tomentoso, densamente cubierto por tricomas estrellados excepto en el margen de los lóbulos, borde

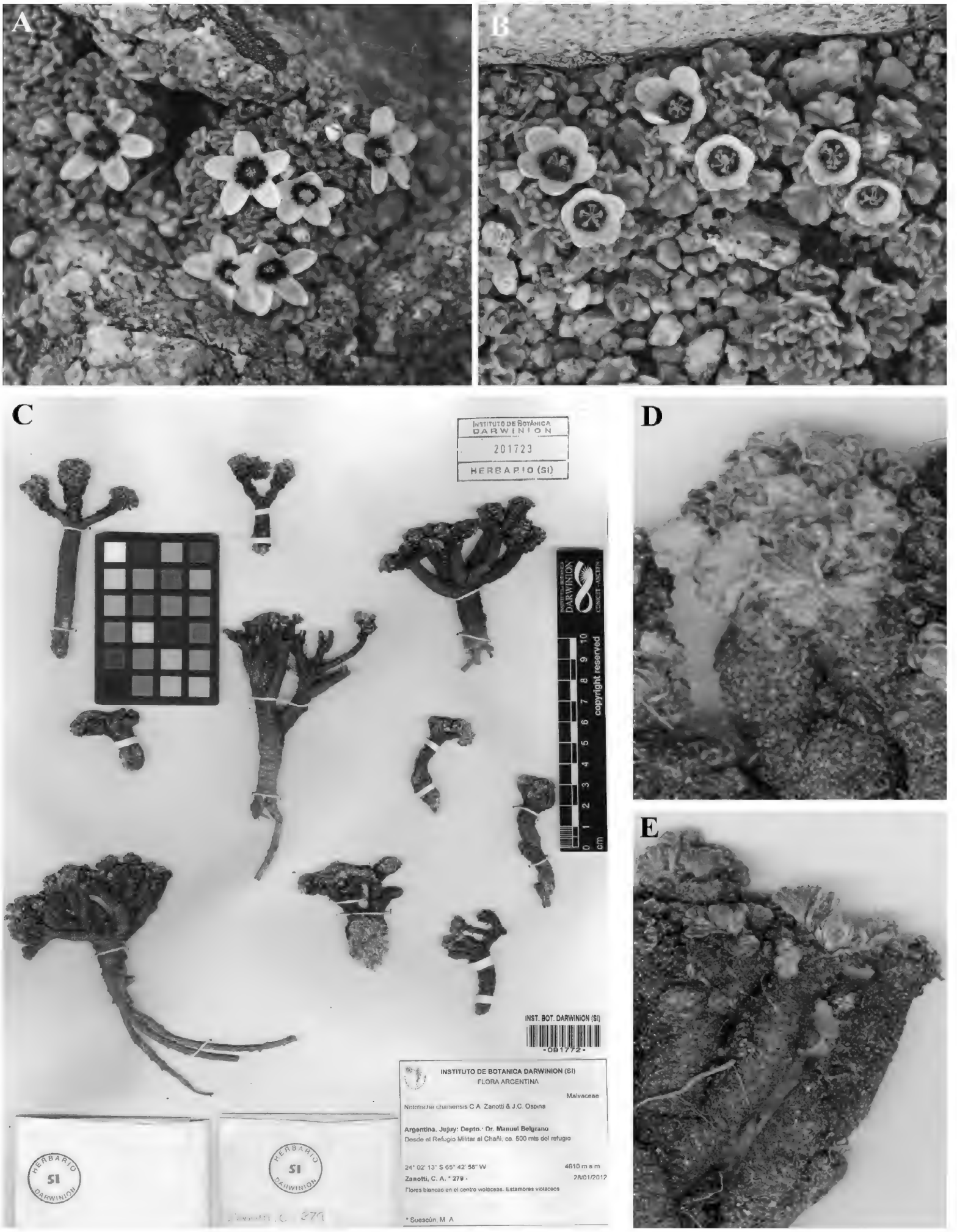

Figura 2. Foto de campo de *Nototriche chaniensis* C. A. Zanotti & J. C. Ospina. —A. Planta con flores masculinas. —B. Planta con flores perfectas. Foto: C. A. Zanotti. —C. Imagen escaneada del holotipo *C. A. Zanotti & M. Suescún 279* (SI). —D. Detalle de las láminas. —E. Detalle del tallo.

de los lóbulos de color rojizo in vivo; hipofilo glabro, o raramente con escasos tricomas y papilas esparcidas; porción libre del pecíolo de 0.3–0.8(–1) × 0.2–0.8 mm, con tricomas estrellados en el margen y con papilas similares al del hipofilo en ambas superficies; porción libre de las estípulas, triangulares, de 0.8–1(–1.5) mm de largo, con tricomas estrellados en el margen; vagina de 2–3(–3.5) × 1.5–2 mm, papilosa en ambas

superficies y con tricomas estrellados en el margen. Flor solitaria, subsésil, inserta por debajo de las partes libres de las estípulas. Calículo ausente. Cáliz de 3.5–5 × 3–4 mm, lóbulos obtusos de 1.8–2.3 × 1.5–2 mm, superficie externa con el nervio medio prominente y con tricomas estrellados hasta el margen de los lóbulos del cáliz, con escasas papilas en la zona basal del cáliz. Nectarios dispuestos en la base de la superficie interna del cáliz, aislados, redondeados, de 0.4–0.8 × 0.5–1 mm, más o menos isodiamétricos. Corola blanca, purpúrea alcanzando el tercio basal; tubo de la corola de 1–2 mm de largo, exteriormente con algunos tricomas estrellados; pétalos obovados-espatulados, de 4.5–5 × 2–2.5 mm, esparcido a densamente piloso en los márgenes y con papilas en ambas superficies de la mitad inferior del pétalo; tubo estaminal de 1–1.5 mm de largo, glabro. Flores masculinas con las anteras violáceas, reunidas en una masa globosa, sin vestigios de gineceo. Flores femeninas con 10 ramas estigmáticas, capitadas y el androceo con anteras abortadas, sin granos de polen. Ovario cónico, de 1.8–2 × 1–1.2 mm, piloso. Fruto no visto.

Fenología. *Nototriche chaniensis* florece en enero. Los frutos no han sido observados.

Distribución y hábitat. *Nototriche chaniensis* es conocida sólo de la colección tipo, en las serranías del Chañi (Depto. Dr. Manuel Belgrano, Jujuy, Argentina). Crece por encima de los 4600 m.s.n.m., al ras del suelo y entre rocas, cohabitando con *Perezia pungens* (Bonpl.) Less., *Werneria cochlearis* Griseb., *Xenophyllum poposum* (Phil.) V. A. Funk (Asteraceae); *Menonvillea virens* (Phil.) Rollins (Brassicaceae); *Calycera herbacea* Cav. var. *sinuata* (Miers) Pontiroli (Calyceraceae); *N. cabrerae* Krapov. (Malvaceae); *Deyeuxia heterophylla* Wedd., *D. vicunarum* Wedd. (Poaceae); y *Jaborosa parviflora* (Phil.) Hunz. & Barboza (Solanaceae).

Categoría de la Lista Roja de la IUCN. *Nototriche chaniensis* es solo conocida de la localidad tipo, por lo tanto de acuerdo al criterio de la IUCN (2001), se considera una especie con Datos Deficientes (DD).

Etimología. *Nototriche chaniensis* recibió esta denominación por ser coleccionada en las serranías del Chañi (Depto. Dr. Manuel Belgrano, Jujuy, Argentina).

Discusión taxonómica. *Nototriche chaniensis* es morfológicamente afín a *N. agyna*, la cual difiere principalmente por presentar el lóbulo medial de la lámina siempre entero, a diferencia del lóbulo medial 3-lobado de *N. agyna*. Otra diferencia es que en *N. agyna* la vagina mide de 6–10 mm de largo y la porción libre del pecíolo 1.5–3 mm de largo, mientras que en *N. chaniensis*, la longitud de la vagina no excede los 3.5 mm de largo y la porción libre del pecíolo no sobrepasa el milímetro de largo.

Es complicado saber si estas son las únicas especies polígamas de *Nototriche* entre las numerosas especies descritas, ya que, para decidir qué condición sexual presentan las especies, es necesario disponer del pie masculino (Krapovickas, 1957). Por esta razón, a la hora de coleccionar el material en el campo, es imprescindible verificar si en el área de colección se encuentran individuos con flores exclusivamente perfectas e individuos con flores exclusivamente masculinas.

Clave para Diferenciar las Especies Polígamas de *Nototriche* (Adaptado de Krapovickas, 1957)

1. Estambres sobrepasando la longitud de los pétalos 2
1′. Estambres no sobrepasando la longitud de los pétalos 3
2. Láminas rómbicas, obovadas a cuneadas .... *N. congesta* A. W. Hill.
2′. Láminas semicirculares a reniformes .... *N. azorella* A. W. Hill.
3. Epifilo e hipofilo tomentoso 4
3′. Epifilo tomentoso e hipofilo glabro 5
4. Vagina, porción libre del peciolo y estípulas con ambas superficies tomentosas; lóbulos de la lámina polilobados ..... *N. sleumeri* Krapov.
4′. Vagina, porción libre del peciolo y estípulas glabros en la superficie adaxial; lóbulos de la lámina enteros a excepción de los lóbulos contiguos al central que son lobados .... *N. polygama* Krapov.
5. Tubo de la corola de 4–5 mm largo .... *N. foetida* Ulbr.
5′. Tubo de la corola de 1–2.5 mm largo 6
6. Nectarios de 1.8–2 × 0.7–1 mm, deltoideos; lóbulo central de la lámina con más de cinco lóbulos ..... *N. cajonensis* Krapov.
6′. Nectarios de 0.8–1 mm, isodiamétricos; lóbulo central de la lámina entero o 3-lobado 7
7. Lóbulo central de la lámina 3-lobado; vagina de 6–10 mm de largo; porción libre del pecíolo de 1.5–3 mm de largo ..... *N. agyna* Krapov.
7′. Lóbulo central de la lámina entero; vagina de 2–3(–3.5) mm de largo; porción libre del pecíolo de 0.3–1 mm de largo. .... *N. chaniensis* C. A. Zanotti & J. C. Ospina

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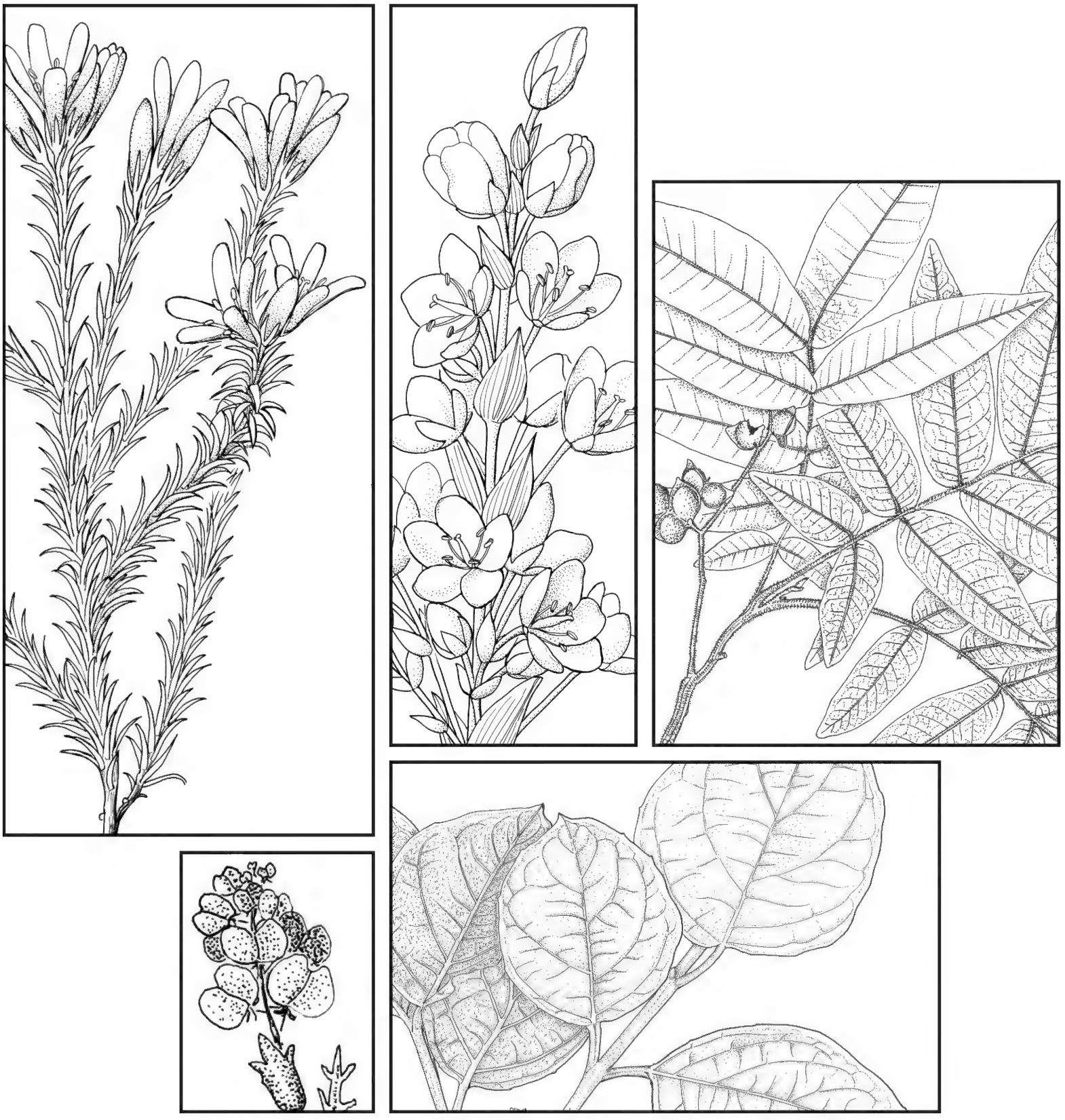

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NOVON

Englerocharis cuzcoensis (Brassicaceae), a New Species from Peru and a Synopsis of *Englerocharis*

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Abstract. *Englerocharis cuzcoensis* Al-Shehbaz (Brassicaceae), a new species from the Peruvian department of Cuzco, is described and illustrated. It is easily distinguished from the closely related *E. ancashensis* Al-Shehbaz, A. Cano & Trinidad by having caducous sepals, ciliate leaf bases, 24 to 32 ovules/seeds per ovary/fruit, and long-sericeous trichomes 0.9–1.5 mm long. The novelty is readily separated from other congeners by having caducous sepals and yellow petals. A synopsis and a key distinguishing the six species of *Englerocharis* Muschl. are presented.

Key words: Brassicaceae, Cruciferae, Cuzco, *Englerocharis*, Peru.

Englerocharis Muschl. (Brassicaceae or Cruciferae), which commemorates the renowned German botanist Heinrich Gustav Adolf Engler (25 March 1844–10 October 1930), remained monospecific for over 80 years since first recognized by Muschler (1908). A second species was added by Al-Shehbaz (1989), and three more have since been described (Al-Shehbaz & Cano, 2011; Al-Shehbaz et al., 2012, 2015). All four species described within the past 25 years (see following treatment) are very rare and narrowly endemic to Peru. By contrast, the generic type, *E. peruviana* Muschl., is more widespread in Bolivia and Peru. The genus is currently assigned to the Thelypodieae (Warwick et al., 2009), a tribe of 244 species (Al-Shehbaz, 2012), updated here to 255 species, of which all except *Pringlea antiscorbutica* R. Br. ex Hook. f. (South Indian Ocean Islands) are native to the New World.

During work on a loan for determination from LPB, three new species of *Lepidium* L. and one of *Englerocharis* were discovered. The new species of *Englerocharis* is described below, and a synopsis of the genus and a key to its species are presented.

Key to the Species of *Englerocharis*

1a. Basal leaves 7- to 9-dentate, 10–15 mm wide. . . . . *E. dentata* Al-Shehbaz & A. Cano
1b. Basal leaves entire, 2–8 mm wide.
  2a. Racemes 8- to 20-flowered; fruit valves pubescent; sepals (3–)4–6 mm.
    3a. Fruits oblong to elliptic, 4–6(–7) mm, less than twice as long as persistent calyx; style in fruit 1–2 mm; petals 5–6 mm; ovules 10 to 16 per ovary; fruiting pedicels 0.5–1 mm . . . *E. peruviana* Muschl.
    3b. Fruits linear-oblanceolate to linear, 8–11 mm, more than twice as long as persistent calyx; style in fruit 0.3–0.6 mm; petals 2–2.5 mm; ovules 18 to 22 per ovary; fruiting pedicels 10–20 mm. . . . . *E. blanca-leoniae* Al-Shehbaz, P. Gonzáles & A. Cano
  2b. Racemes 2- to 5-flowered; fruit valves glabrous; sepals 1.8–2.2(–3) mm.
    4a. Leaves green, lanceolate, glabrous or sparsely sericeous adaxially; style 1–1.7 mm; racemes ebracteate. . . . . *E. pauciflora* Al-Shehbaz
    4b. Leaves silvery gray, broadly oblanceolate to obovate, densely sericeous adaxially; style 0.2–0.5 mm; racemes bracteate.

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5a. Sepals persistent; ovules/seeds 8 to 10 per ovary/fruit; leaf base not ciliate; leaf trichomes 0.4–0.5 mm; fruit 1–1.3 mm wide . . . . . *E. ancashensis* Al-Shehbaz, A. Cano & Trinidad

5b. Sepals caducous; ovules/seeds 24 to 32 per ovary/fruit; leaf base ciliate; leaf trichomes 0.9–1.5 mm; fruit 2–2.2 mm wide . . . . . *E. cuzcoensis* Al-Shehbaz

1. Englerocharis ancashensis Al-Shehbaz, A. Cano & Trinidad, Kew Bull. 67: 254. 2012. TYPE: Peru. Ancash: Prov. Pallasca, Distr. Pampas, Cordillera Pelagatos, 0192627–0193871 UTM [8°9′42.7″–8°10′6.5″S], 9095651–9096392 UTM [77°46′40.8″–77°47′21.3W″], 4100–4500 m, Apr. 2011, *A. Cano, H. Trinidad, D. Rodríguez-Paredes & D. W. Ramirez 20320* (holotype, USM!; isotypes, K!, MO-6340283!).

Distribution. This species is endemic to Peru (Ancash Dept.) and is known from only three collections.

2. Englerocharis blanca-leoniae Al-Shehbaz, P. Gonzáles & A. Cano, Harvard Pap. Bot. 20: 1. 2015. TYPE: Peru. Puno: Prov. Carabaya, Distr. Macusani, Pacaje–Chacopata, 4897 m, 17 Mar. 2014, *P. Gonzáles 3059* (holotype, USM!; isotype, MO-6602607!).

Distribution. This species is endemic to Peru and is known only from the type collection.

3. Englerocharis cuzcoensis Al-Shehbaz, sp. nov. TYPE: Peru. Cuzco: Cordillera de Vilcanota, cuenca de la laguna Sibinacocha, entre Rititica y Yurak, 13°46′01″S, 71°05′17″W, 5400–5498 m, 6 Apr. 2012, *R. I. Meneses, K. Yager, J. Farfán, A. Tupayachi & Alberto 5454* (holotype, MO-6724251!; isotype, LPB not seen). Figure 1.

Diagnosis. The species is readily distinguished from the other *Englerocharis* species by a combination of entire, silvery leaves, glabrous fruit, bracteate and 2- to 5-flowered racemes, 24 to 32 ovules per ovary, and caducous sepals 2.5–3 mm long.

Herbs, perennial, densely caespitose, scapose; caudex few-branched, to 1.5 cm diam., densely covered with dry persistent leaf remains of previous years; rosettes 1–2 cm diam. Basal leaves rosulate, obovate to broadly oblanceolate, 5–10 × 1.5–4 mm, silvery gray, adaxially antrorse sericeous with appressed simple trichomes 0.9–1.5 mm, ciliate along base, glabrous abaxially, apex obtuse to subacute, margin entire, base attenuate; cauline leaves absent. Racemes 2- to 5-flowered, bracteate, not elongated in fruit; peduncle 5–10 mm, glabrous; bracts linear to narrowly lanceolate, 4–5 × 0.7–1 mm; pedicels 3–4 mm, sparsely pilose. Sepals yellow, oblong, 2.5–3 mm, caducous, puberulent with minute trichomes ca. 0.1 mm; petals yellow, broadly obovate, 3–4 × 1.7–2.2 mm, dark veined when dry, rounded at apex; claw 1–1.5 mm; filaments yellow, 2–2.5 mm; anthers ovate, 0.5–0.6 mm. Fruit oblong, 4–5 × 2–2.2 mm; ovules/seeds 24 to 32 per ovary/fruit; valves glabrous, obtuse at both ends, with a distinct midvein; style 0.4–0.5 mm; septum perforate. Seeds oblong-ovoid, light brown, 0.8–1.1 × 0.4–0.5 mm.

Habitat and distribution. *Englerocharis cuzcoensis* is found on altoandean vegetation dominated by grassland. It is endemic to Peru (Cuzco Dept.) and known only from the type collection.

Etymology. This novelty is named after Cuzco Department, Peru.

Discussion. *Englerocharis cuzcoensis* is most closely related to *E. ancashensis*, which it resembles in having silvery adaxial leaf surface densely covered with antrorsely appressed sericeous trichomes, 2- to 5-flowered bracteate racemes, and glabrous fruit with perforate septum. From the latter, *E. cuzcoensis* is easily distinguished by having longer leaf trichomes 0.9–1.5 mm (vs. 0.4–0.5 mm), pilose (vs. glabrous) pedicels, ciliate (vs. glabrous) leaf base, completely glabrous (vs. subapically sericeous) abaxial leaf surface, and 24 to 32 (vs. eight to 10) ovules/seeds per ovary/fruit. It is also readily distinguished from the other five species of *Englerocharis* by having caducous (vs. persistent) sepals and yellow (vs. white) petals.

4. Englerocharis dentata Al-Shehbaz & A. Cano, Harvard Pap. Bot. 16: 275. 2011. TYPE: Peru. Huancavelica: Prov. Huaytará, Pilpichaca, 523163 [13°18′4.9″S], 8528939 [74°47′10.1″W], 4500–4550 m, 4 July 2010, *A. Cano, W. Mendoza & A. Delgado 19645* (holotype, USM!; isotype, MO-6240734!).

Distribution. *Englerocharis dentata* is endemic to Peru (Huancavelica Dept.) and known only from the type collection.

5. Englerocharis pauciflora Al-Shehbaz, Nordic J. Bot. 8: 624. 1989. TYPE: Peru. Junin: Prov. Jauja, Tarma-Jauja rd., 28 km from Tarma, in vernal pools, 78°38′W, 11°35′S, 3950 m, 10 Jan. 1984, *D. N. Smith 5684* (holotype, GH-00019118!; isotypes, MO-3584165!, USM-000228!).

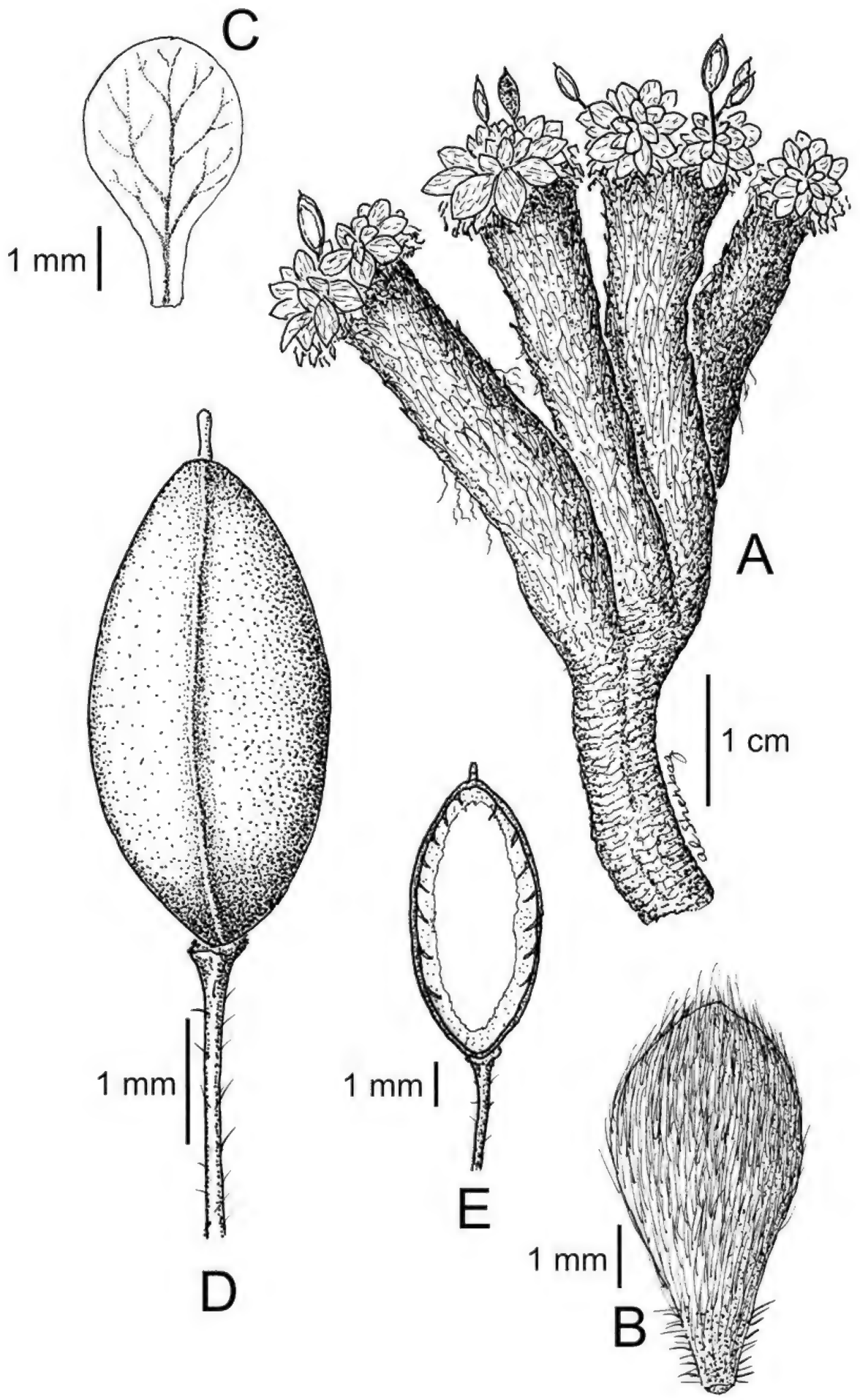

Figure 1. *Englerocharis cuzcoensis* Al-Shehbaz. —A. Plant. —B. Rosette leaf. —C. Petal. —D. Fruit and fruiting pedicel. —E. Fruit and fruiting pedicel with valves and seeds removed showing replum and perforated septum. Drawn by Al-Shehbaz from the holotype *Meneses et al. 5454* (MO-6724251).

Distribution. *Englerocharis pauciflora* is endemic to Peru (Junin Dept.) and known only from the type collection.

6. Englerocharis peruviana Muschl., Bot. Jahrb. Syst. 40: 276. 1908. TYPE: Peru. Junin: Lima–Oroya rd., above Hacienda Arapa, near Yauli, 4600 m, 18–27 Jan. 1902, *A. Weberbauer 331* (holotype, B-10_0242871!; isotype, BAA!).

Englerocharis peruviana var. *leiocarpa* O. E. Schulz, Pflanzenr. IV. 105(Heft 86): 197. 1924. TYPE: Peru. Ancash: Prov. Pallasca, Cordillera Pelagatos, 4450 m, 28 Jan. 1920, *A. Weberbauer 7231* (holotype, B!; isotypes, F-0042180!, US-00344987!).

Distribution. *Englerocharis peruviana* is known from Bolivia (La Paz Dept.) and Peru (Ancash, Apurímac, Junin, La Libertad, Lima).

Acknowledgments. I am grateful to Stephan G. Beck (LPB) for sending a loan of undetermined Brassicaceae for my study. Partial funding for this research was supported by the United States National Science Foundation OPUS grant DEB-1252905, for which I am profoundly thankful.

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Five New Species of *Lepidium* (Brassicaceae): *L. pabotii* (Iran), *L. arequipa* (Peru), and *L. lapazianum*, *L. linearilobum*, and *L. stephan-beckii* (Bolivia)

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ABSTRACT. The Iranian *Lepidium pabotii* Al-Shehbaz, Peruvian *L. arequipa* Al-Shehbaz, and Bolivian *L. lapazianum* Al-Shehbaz & S. G. Beck, *L. linearilobum* Al-Shehbaz, and *L. stephan-beckii* Al-Shehbaz (Brassicaceae) are described and illustrated. Their relationships to nearest relatives and means of distinguishing them are discussed.

Key words: Bolivia, Brassicaceae, Cruciferae, Iran, *Lepidium*, Peru.

Lepidium L. is the second-largest genus in the Brassicaceae (Cruciferae) after *Draba* L. (ca. 400 spp.) and includes over 250 species (Al-Shehbaz, 2012). *Lepidium*, *Cardamine* L., and *Rorippa* Scop. are the only genera in the family with native species on all continents except for Antarctica.

Based on extensive molecular phylogenetic studies (Mummenhoff et al., 2001, 2004, 2006, 2009, and references therein) and closer evaluation of morphology, the limits of *Lepidium* have recently been expanded to include several smaller genera, including *Cardaria* Desv., *Coronopus* Zinn, *Hymenophysa* C. A. Mey., *Stroganowia* Kar. & Kir., *Stubendorffia* Schrenk ex Fisch., and *Winklera* Regel (Al-Shehbaz et al., 2002; Al-Shehbaz & Mummenhoff, 2011). Approximately 95% of *Lepidium* species have dehiscent, angustiseptate fruit (flattened at a right angle to the septum), 2-ovuled ovaries, and copiously mucilaginous seeds (author's compilation). The remaining ca. 5% of species, which had been assigned to the above segregates, lack one or more of these four characteristic features.

During the past several years, I have been working on a worldwide monograph of *Lepidium*. Recent visits to the herbaria G and P, as well as the study of a loan sent from LPB, led to the discovery of the following five species, four of which are from Bolivia and Peru. The novelties are quite distinct morphologically from their nearest relatives and are therefore recognized as distinct species. Although a synopsis of South American species of *Lepidium* was published seven years ago (Al-Shehbaz, 2010), our knowledge of the genus is still incomplete, especially from these two South American countries. As currently recognized, the genus includes at least some 260 species worldwide.

1. Lepidium arequipa Al-Shehbaz, sp. nov. TYPE: Peru. Arequipa: Camaná, Quebrada el Toro, 600–800 m, 2 Nov. 1998, *FLSP 1094* (holotype, P-05099810!; isotype, HUSA n.v.). Figure 1.

Diagnosis. From the other South American species of *Lepidium*, *L. arequipa* Al-Shehbaz is distinguished by being an annual with auriculate cauline leaves, two median stamens, and suborbicular and puberulent fruit without an apical notch.

Herbs annual. Trichomes slender, straight, spreading, to 0.3 mm. Stems ca. 15 cm, erect, simple at base, branched distally, hirsute. Basal leaves not rosulate, soon withered; lowermost cauline leaves with ciliate petioles 1.5–3 cm, spatulate to broadly oblanceolate, 7–10 × 2–2.5 cm, simple, serrate, hirsute with spreading trichomes; middle and upper cauline leaves sessile, auriculate, serrate, gradually reduced in size upward. Racemes ebracteate, corymbose, dense, slightly elongated in fruit; rachis hirsute as stem; fruiting pedicels 7–10 mm, hirsute all around, terete, narrowly winged, divaricate-ascending, straight, persistent. Sepals oblong, 1.5–1.8 mm, caducous, somewhat spreading, equal, white-margined, puberulent adaxially; petals white, spreading, longer than sepals, 2.2–3 × 0.7–1 mm; blade oblanceolate, apex obtuse; claw distinct, shorter than sepals, 0.7–1 mm, glabrous; stamens 2, equal in length, median; filaments white, 1.8–2.2 mm, glabrous, slender at base; anthers ovate, ca. 0.3 mm, purple; nectar glands 4, median, toothlike, 1 on each side of median stamen. Fruit dehiscent, suborbicular, immature ones 5–5.5 × 4–4.5 mm, strongly angustiseptate, not inflated; valves papery, veinless, puberulent throughout, smooth, strongly keeled, narrowly winged to base, base obtuse, apex subtruncate to rounded; apical notch absent; septum complete; style ca. 0.5 mm, extended well beyond fruit apex; stigma capitate, entire. Seeds 1 per locule, immature ones oblong-ovate, ca. 2 × 1 mm, wingless; cotyledons incumbent.

Distribution. *Lepidium arequipa* is endemic to Peru (Arequipa Dept.).

Etymology. The species epithet *arequipa*, named after the Peruvian department of Arequipa, is a noun

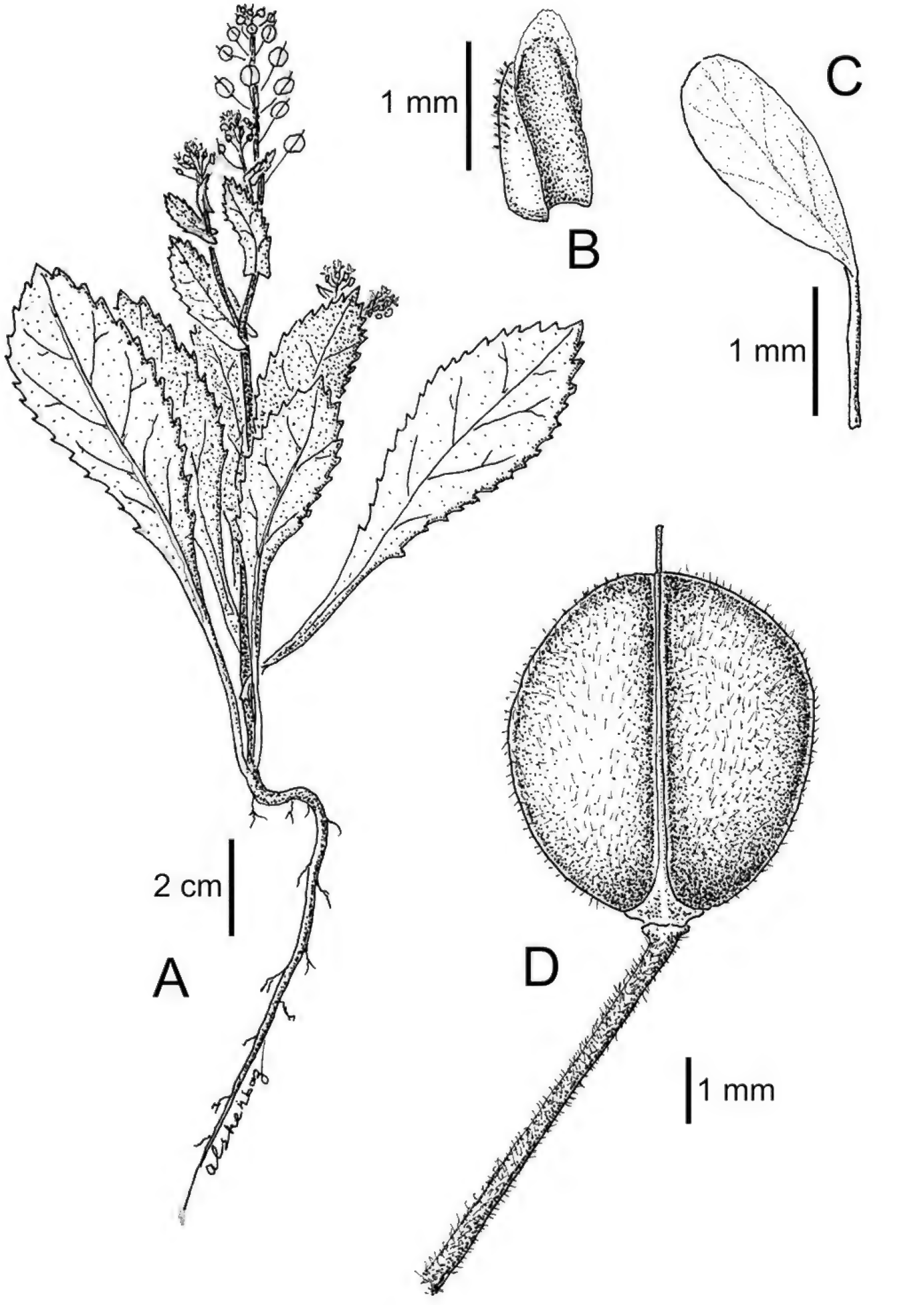

Figure 1. *Lepidium arequipa* Al-Shehbaz. —A. Plant. —B. Sepal. —C. Petal. —D. Fruit and fruiting pedicel. Drawn by Al-Shehbaz from the holotype *FLSP 1094* (P-05099810).

used in apposition and, therefore, should be maintained according to Article 23.5 of the International Code of Botanical Nomenclature (McNeill et al., 2012).

Discussion. *Lepidium arequipa* is most closely related to the Peruvian-endemic *L. crassius* (C. L. Hitchc.) Al-Shehbaz (Arequipa Dept.) and *L. cyclocarpum* Thell.

(Lima Dept.), which it resembles in having obovate to oblanceolate, serrate lowermost leaves; ebracteate racemes; white flowers; and orbicular to suborbicular, strongly angustiseptate, usually unnotched fruits with distinct styles extended well beyond the fruit apex. The novelty also resembles *L. crassius* in having auriculate cauline leaves, petals 2–3 mm, and narrowly winged fruiting pedicels densely puberulent all around. However, *L. arequipa* differs by being a small annual to 1.5 dm (vs. perennial 2.5–5 dm) and by having two median (vs. two lateral and two median) stamens; toothlike (vs. filiform) nectar glands; style ca. 0.5 mm (vs. 0.7–1 mm); and puberulent (vs. glabrous), winged (vs. wingless) fruit 5–5.5 × 4–4.5 mm (vs. 3–4.5 mm diam.). *Lepidium arequipa* also resembles *L. cyclocarpum* by being an annual with only two median stamens. It differs from the latter by having auriculate (vs. non-auriculate) cauline leaves; narrowly winged (vs. wingless) and longer (7–10 mm vs. 3–5 mm) fruiting pedicels hirsute all around (vs. glabrous abaxially and puberulent adaxially); larger petals (2.2–3 × 0.7–1 mm vs. 1–1.5 × 0.2–0.5 mm); and larger (5–5.5 × 4–4.5 mm vs. 3.5–4 × 3–3.8 mm), puberulent (vs. glabrous), veinless (vs. reticulate veined), and apically unnotched (vs. notched) fruit.

2. Lepidium lapazianum Al-Shehbaz & S. G. Beck, sp. nov. TYPE: Bolivia. La Paz: Prov. Aroma, de la carretera La Paz–Oruro, 43 km hacia Luribay, 3000 m, matorral abierto con plantes espinosas, sobre ladera no consolidada, 4 Jan. 1991, *S. G. Beck 17936* (holotype, LPB!). Figure 2.

Diagnosis. *Lepidium lapazianum* Al-Shehbaz & S. G. Beck differs from the South American congeners by a combination of annual habit, entire basal leaves, narrowly winged pedicels, ovate fruit, wingless seeds, and caducous sepals.

Herbs annual. Trichomes slender, straight or curved, 0.05–0.1 mm. Stems 5–8 cm, erect, simple basally, branched above middle, puberulent throughout. Basal leaves not rosulate, soon withered, oblanceolate, entire, glabrous; cauline leaves linear to narrowly oblanceolate, 1.5–2 cm × 1–3 mm, entire or subapically 1- or 2-toothed on each side, attenuate to base, non-auriculate, apex acute. Racemes ebracteate, corymbose, lax, elongated in fruit, with 10 to 20 fruits on terminal raceme; rachis straight, puberulent as stems; fruiting pedicels 2–3.5 mm, puberulent adaxially, glabrous abaxially, terete, narrowly winged, divaricate, straight or slightly arcuate, persistent. Sepals ovate, 0.7–0.8 mm, caducous, ascending, equal, glabrous; petals white, linear, shorter than sepals, ca. 0.4 × 0.1 mm, claw undifferentiated; stamens 2, equal in length, median; filaments 0.4–0.5 mm, glabrous, slender at base; anthers ovate, ca. 0.1 mm; nectar glands 4, median, toothlike, 1 on each side of stamens. Fruit dehiscent, broadly ovate, 2.2–2.5 × 1.8–2 mm, strongly angustiseptate, not inflated; valves papery, veinless, glabrous, smooth, strongly keeled, apically narrowly winged, wing to 0.1 mm; apical notch V-shaped, 0.1–0.2 mm deep; septum complete; style obsolete, included in apical notch of fruit; stigma capitate, entire. Seeds 1 per locule, ovate, 1.2–1.3 × 0.6–0.7 mm, wingless; seed coat minutely reticulate; cotyledons incumbent, entire.

Distribution. *Lepidium lapazianum* is endemic to Bolivia (La Paz Dept.).

Etymology. The species is named after the Bolivian department of La Paz.

Discussion. *Lepidium lapazianum* resembles *L. gracile* (Chodat & Hassl.) Boelcke (Argentina: Chaco, Corrientes; Paraguay) and *L. stuckertianum* (Thell.) Boelcke (Argentina: Catamarca, Chaco, Corrientes, Formosa, La Pampa, Salta, San Juan, San Luís, Santa Fe, Santiago del Estero, Tucumán) in being a puberulent annual with linear to narrowly oblanceolate uppermost cauline leaves, ovate sepals less than 1 mm, two median stamens, fruiting pedicels puberulent adaxially and glabrous abaxially, and minutely notched fruit to 3 mm. It differs from both species by having entire (vs. pinnatisect) basal leaves and terminal fruiting racemes with 10 to 20 (vs. 40 to 110) fruits. From *L. gracile*, the novelty also differs by having entire or rarely subapically toothed (vs. deeply trifid or pinnatisect) cauline leaves, narrowly winged (vs. wingless) fruiting pedicels, broadly ovate (vs. orbicular) fruit, and wingless (vs. winged) seeds. *Lepidium lapazianum* also differs from *L. stuckertianum* by having lax (vs. very dense) fruiting racemes, broadly ovate (vs. orbicular or orbicular-elliptic) fruits, caducous sepals (vs. persistent or caducous after fruit maturity), and some curved (vs. always straight) stem trichomes.

3. Lepidium linearilobum Al-Shehbaz, sp. nov. TYPE: Bolivia. Dpto. La Paz: Prov. Omasuyos, de Huarina unos 10 km hacia Tiquina, pasando el Hotel Titicaca, plantes pioneras sobre quebrada seca y ancho, entrando al lago Titicaca, 16°13′S, 68°40′W, 3850 m, 2 Oct. 1997, *S. G. Beck 24393* (holotype, MO-04869322!; isotype, LPB!). Figure 3.

Diagnosis. *Lepidium linearilobum* Al-Shehbaz is easily separated from the other perennial South American species of *Lepidium* by having leaves divided into linear, entire segments, linear petals shorter than the sepals, caducous sepals, and obovate fruit.

Herbs perennial, with simple caudex. Trichomes slender, usually recurved, 0.05–0.25 mm. Stems 3 to 12 from caudex, 2–9 cm, decumbent, simple or few-branched above middle, densely puberulent. Basal leaves

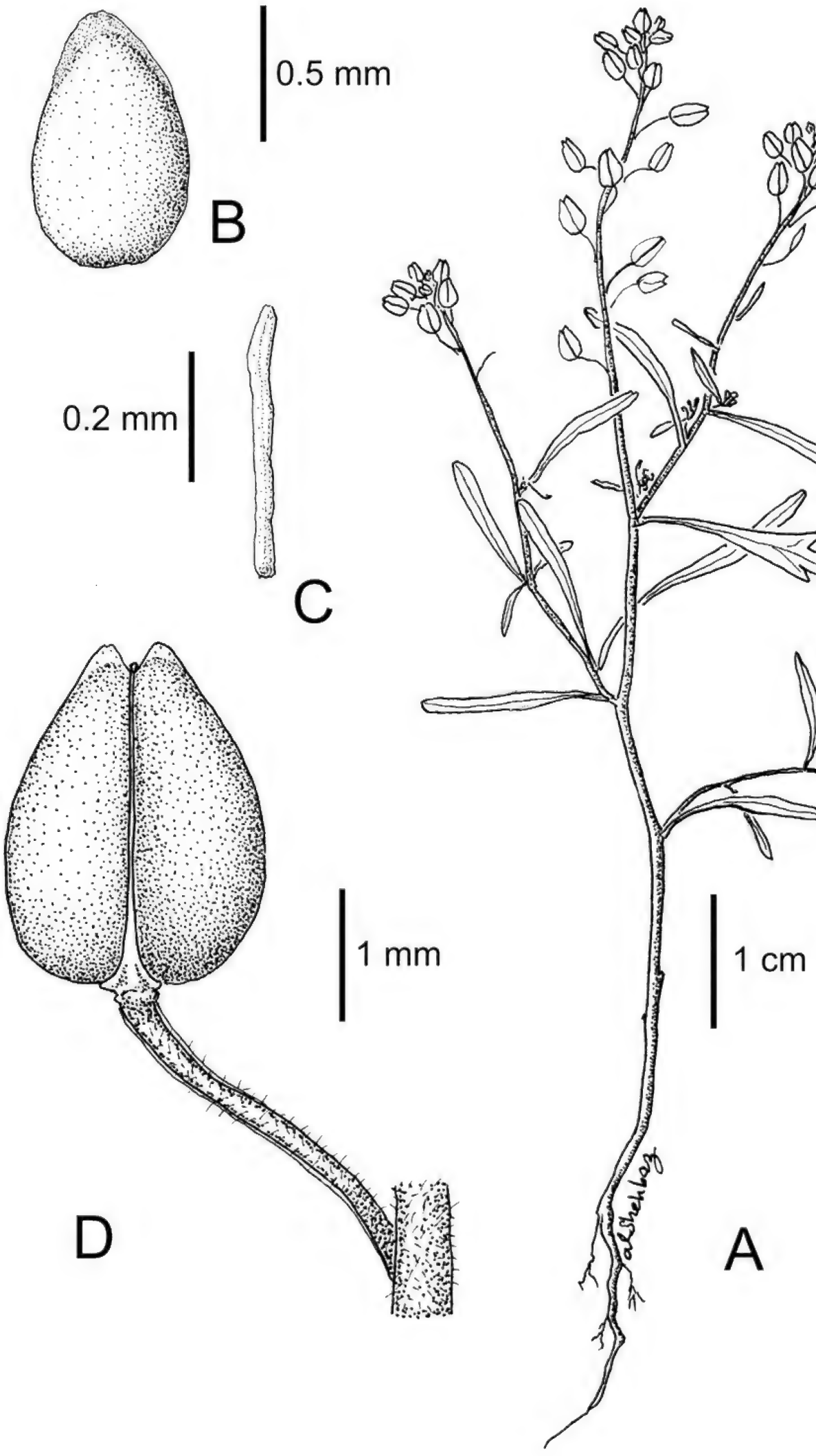

Figure 2. *Lepidium lapazianum* Al-Shehbaz & S. G. Beck. —A. Plant. —B. Sepal. —C. Petal. —D. Fruit and fruiting pedicel. Drawn by Al-Shehbaz from the holotype *S. G. Beck 17936* (LPB).

rosulate, 1–3 cm including petiole, pinnatisect, subglabrous or puberulent; petiole 3–15 mm, broadly expanded and 2–3.5 mm wide at base; lateral lobes 1 or 2 on each side, linear, 3–7 × 0.3–0.5 mm, slightly smaller than terminal lobe, entire, undivided or deeply bi- or trifid; cauline leaves broadly petiolate, non-auriculate at base,

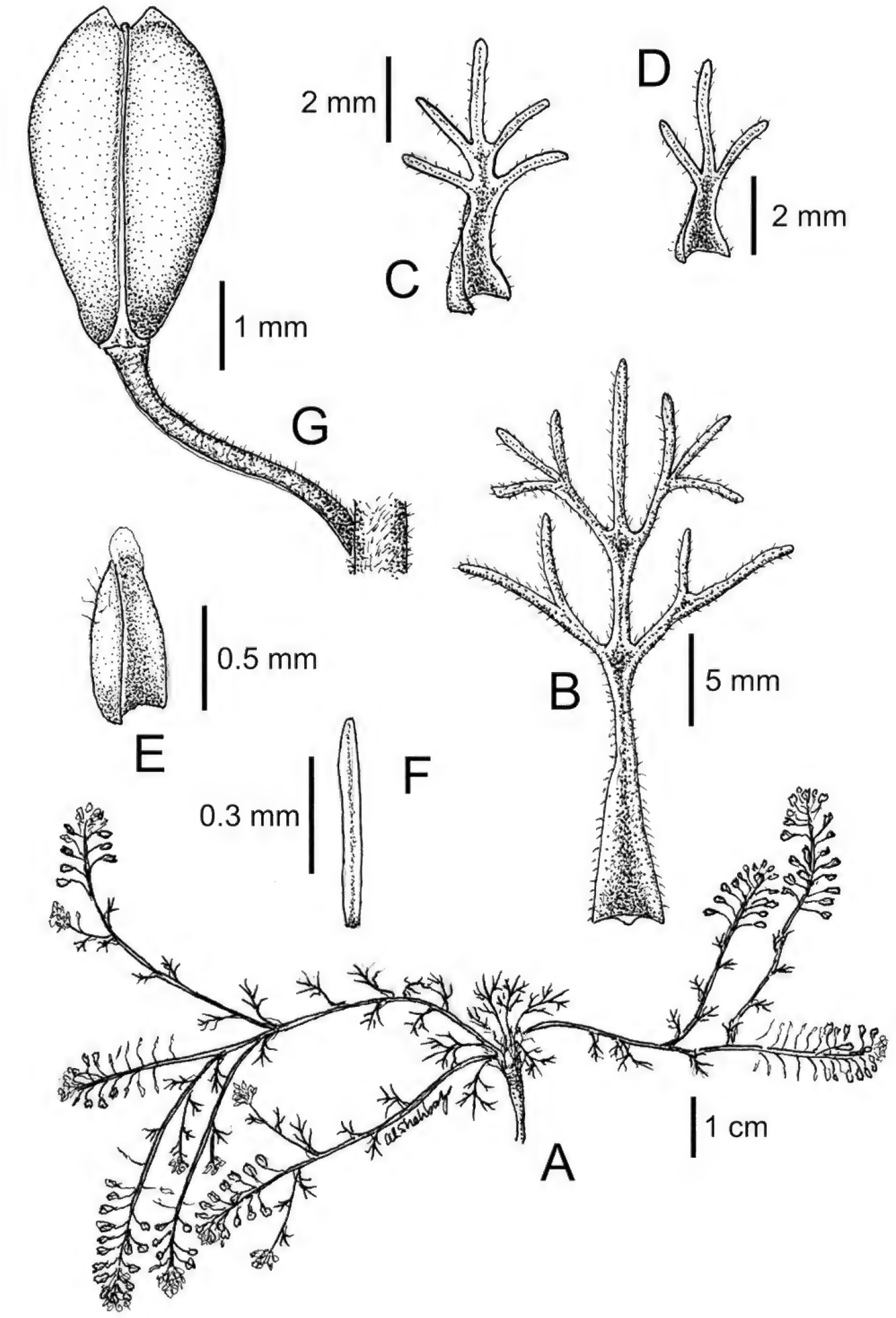

Figure 3. *Lepidium linearilobum* Al-Shehbaz. —A. Plant. —B. Basal leaf. —C. Middle cauline leaf. —D. Uppermost cauline leaf. —E. Sepal. —F. Petal. —G. Fruit and fruiting pedicel. Drawn by Al-Shehbaz from the holotype *S. G. Beck 24393* (MO-04869322).

pinnatisect, entire, gradually reduced in size upward, uppermost trifid. Racemes ebracteate, corymbose, dense, elongated in fruit; rachis puberulent as stem; fruiting pedicels 2.5–4 mm, puberulent adaxially, glabrous abaxially, terete, narrowly winged, ascending to divaricate at base, gradually recurved toward apex, persistent. Sepals

ovate, 0.8–0.9 mm, caducous, ascending, equal, puberulent; petals white, shorter than sepals, linear, 0.6–0.7 × 0.08–0.12 mm, undifferentiated into blade and claw; stamens 2, equal in length, median; filaments 0.6–0.7 mm, glabrous, slender at base; anthers ovate, 0.15–0.25 mm; nectar glands 4, median, 1 on each side of filament base, toothlike. Fruit dehiscent, obovate, 3–3.8 × 2–2.3 mm, strongly angustiseptate, not inflated; valves papery, veinless, glabrous, smooth, strongly keeled, apically narrowly winged; apical notch V-shaped, 0.3–0.4 mm deep; septum complete; style 0.05–0.1 mm, included in apical notch of fruit; stigma capitate, entire. Seeds 1 per locule, oblong, 1.3–1.4 × 0.7–0.8 mm, wingless, seed coat smooth; cotyledons incumbent, entire.

Phenology. Flowering and fruiting times for *Lepidium linearilobum* are September through November.

Distribution. *Lepidium linearilobum* is endemic to Bolivia (La Paz and Tarija Depts.).

Etymology. The species epithet reflects the shape of the ultimate leaf lobes.

Discussion. Plants of *Lepidium linearilobum* were previously misidentified as *L. depressum* Thell. (Argentina, Bolivia, Peru) or *L. abrotanifolium* Turcz. (Bolivia, Peru, Ecuador) because all are similar in being perennials with simple caudex, puberulent stems with short trichomes to 0.3 mm, pinnatifid or pinnatisect basal leaves, non-auriculate cauline leaves, arcuate fruiting pedicels to 4 mm, two median stamens, and apically minutely winged and notched fruit 2.5–4 mm. However, examination of the type collections of the latter two species clearly showed that three species are involved. From *L. depressum*, the new species differs by having basal and cauline leaves divided into entire linear lobes (vs. serrate or laciniate oblong lobes), readily caducous sepals (vs. persistent to fruit maturity), linear (vs. spatulate) petals shorter than (vs. subequaling) sepals and 0.6–0.7 × 0.08–0.12 mm (vs. 1–1.3 × 0.3–0.6 mm), obovate (vs. elliptic) fruit, and styles included in (vs. exserted from) an apical notch 0.3–0.4 mm deep (vs. 0.05–0.15 mm deep). *Lepidium linearilobum* differs from *L. abrotanifolium* by its decumbent (vs. erect to ascending) stems puberulent with usually recurved (vs. straight) trichomes, pinnatisect (vs. pinnatifid) leaves with one or two (vs. three to eight) lateral lobes on each side that are linear (vs. oblong) and entire (vs. serrate or laciniate), abaxially glabrous fruiting pedicels (vs. puberulent all around, at least proximally), readily caducous (vs. persistent) sepals, petals shorter than (vs. equaling) sepals, and obovate (vs. oblong to narrowly oblong-ovate) fruit.

Paratypes. BOLIVIA. **La Paz:** Prov. Murillo, La Paz, 4100 m, 8 Dec. 1986, *Beck 13082* (LPB, MO). **Tarija:** Prov. Eustaquio Méndez, Iscayachi 17 km hacia Curqui, 3650 m, 10 Nov. 1993, *Beck, Kiesling & Metzing 22071* (LPB, SI).

4. Lepidium pabotii Al-Shehbaz, sp. nov. TYPE: Iran. Fars: 18 km NW Ardekan [Ardakan], 2750 m, 14 July 1959, *H. Pabot 2454* (holotype, G-00446400!). Figures 4, 5.

Diagnosis. *Lepidium pabotii* Al-Shehbaz differs from the other rhizomatous *Lepidium* taxa with indehiscent fruit by being diminutive plants to 5 cm tall and by having persistent, rosulate, and densely hirsute leaves, non-auriculate cauline leaves, and keeled pubescent fruit with fenestrate septum.

Herbs perennial, hirsute throughout, rhizomatous. Trichomes slender, straight or slightly curved, 0.1–0.25 mm. Stems 3–5 cm, decumbent, simple or few-branched apically. Basal leaves persistent, rosulate, densely hirsute; petiole 0.5–1.7 cm; blade oblong, 1–4 × 0.5–1.5 cm, simple, denticulate; middle and upper cauline leaves sessile, oblong, reduced in size upward, base cuneate, non-auriculate, margin denticulate. Racemes ebracteate, corymbose, dense, hardly elongated in fruit; rachis hirsute with straight or slightly curved trichomes; fruiting pedicels 3–5 mm, hirsute all around, terete, wingless, divaricate, straight or slightly curved, persistent. Sepals oblong, 1.2–1.5 mm, caducous, ascending, equal; petals white, ascending, longer than sepals, 2.2–2.5 × 0.5–0.6 mm; blade narrowly oblanceolate, apex obtuse; claw slightly longer than sepals, 1.5–1.7 mm, glabrous; stamens 6, tetradynamous; filaments 1.8–2.2 mm, glabrous, slender at base; anthers oblong, ca. 0.5 mm; nectar glands confluent, subtending bases of all filaments, not extended into 6 teeth between them. Fruit indehiscent, subglobose, 2.5–3 mm diam., inflated; valves papery, veinless, hirsute, smooth, keeled at midvein, apically wingless, cuneate to obtuse at base; apical notch absent; septum perforated; style 0.2–0.7 mm; stigma capitate, entire. Seeds 1 per locule, oblong-ovate, 1.3–1.4 × 0.7–0.8 mm, wingless; cotyledons incumbent, entire.

Distribution. *Lepidium pabotii* is endemic to SW Iran in Fars Province.

Etymology. The new species is named in honor of Henri A. Pabot, who gathered the type material and made numerous other collections of Iranian plants currently housed at G.

Discussion. *Lepidium pabotii* is closely related to *L. chalepense* L., *L. appelianum* Al-Shehbaz, and *L. propinquum* Fisch. & C. A. Mey., all of which are rhizomatous perennials with indehiscent and wingless fruit, distinct styles, white flowers, corymbose racemes, dentate or denticulate leaves, and confluent nectar

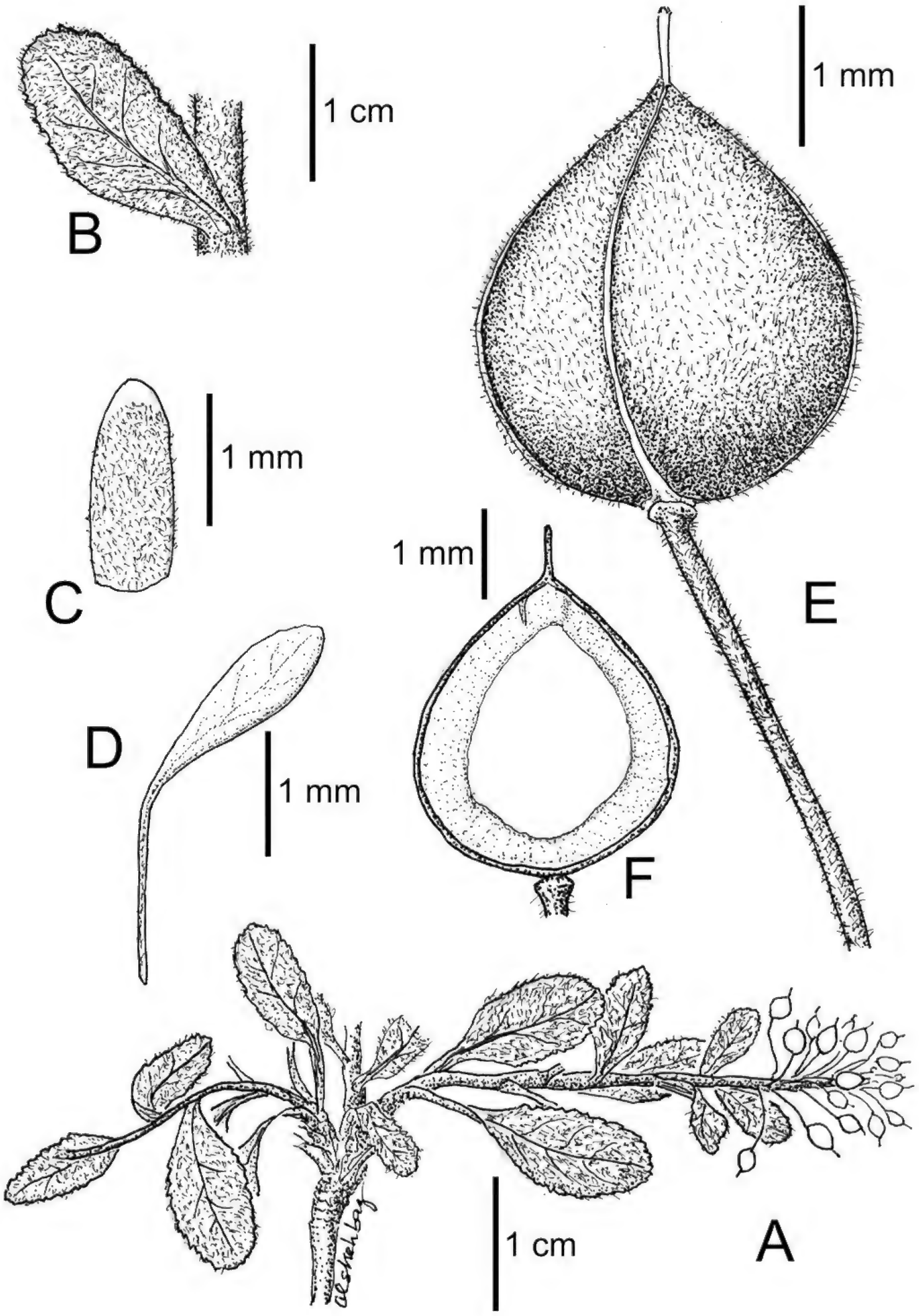

Figure 4. *Lepidium pabotii* Al-Shehbaz. —A. Fruiting plant. —B. Middle cauline leaf. —C. Sepal. —D. Petal. —E. Fruit and fruiting pedicel. —F. Replum and septum. Drawn by Al-Shehbaz from the holotype *H. Pabot 2454* (G-00446400).

glands. The other three species had previously been placed in the genus *Cardaria*. From *L. appelianum* (western China, Kazakhstan, Kyrgyzstan, northern Pakistan, south-central Russia, Tajikistan, Turkmenistan, and Uzbekistan; naturalized in North America and Argentina), the new species differs by having decumbent (vs. erect

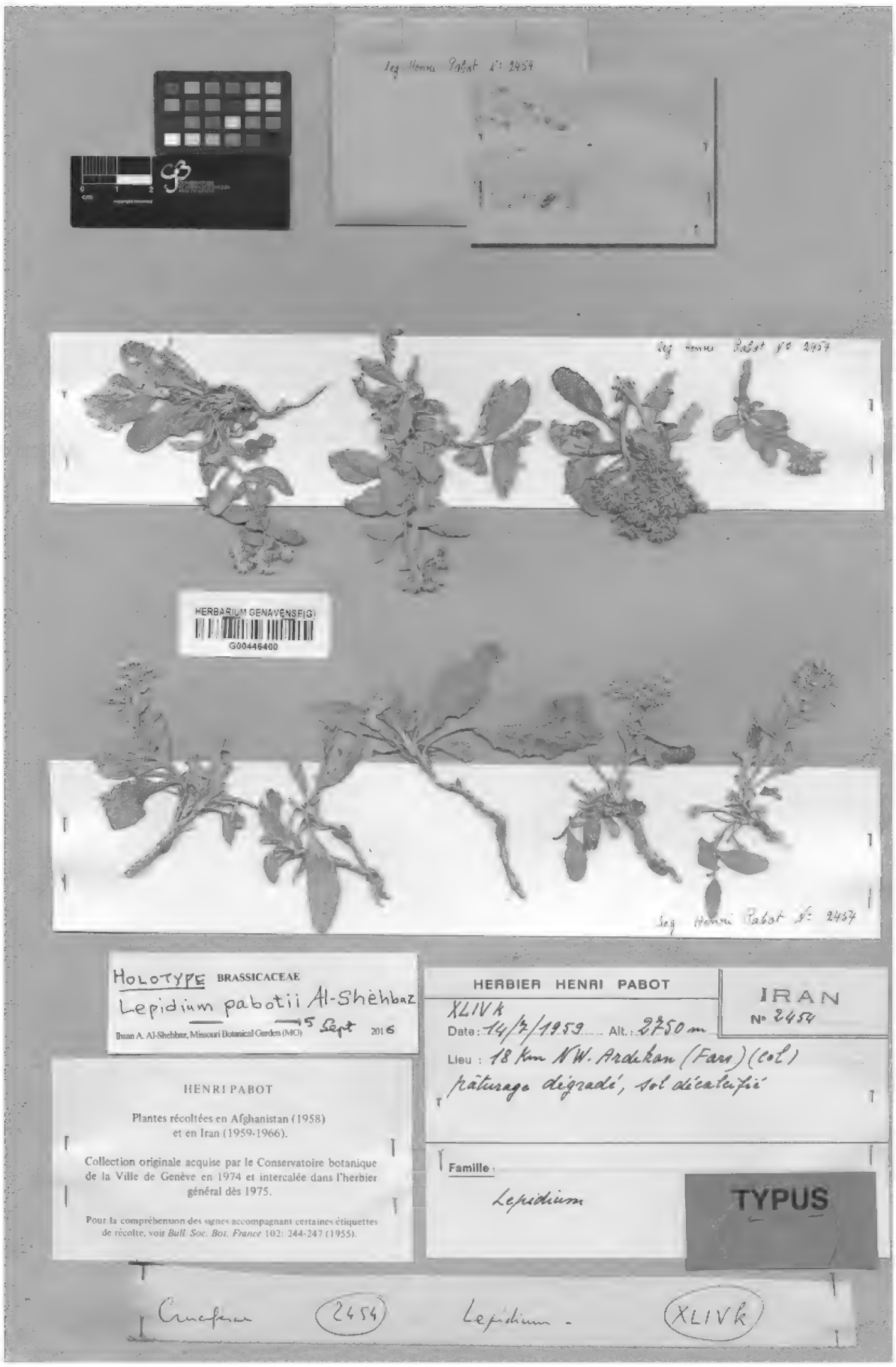

Figure 5. *Lepidium pabotii* Al-Shehbaz. Holotype *H. Pabot 2454* (G-00446400).

to ascending) stems only 3–5 cm tall (vs. [10–] 15–50 cm tall), persistent (vs. soon withered) and rosulate (vs. non-rosulate) basal leaves, non-auriculate (vs. strongly auriculate to sagittate) middle cauline leaves, fruiting pedicels 3–5 mm (vs. 5–15 mm), narrowly oblanceolate (vs. broadly obovate) petals 2.2–2.5 × 0.5–0.6 mm (vs. 2.8–4 × 1–3 mm), and subglobose (vs. globose) fruit 2.5–3 mm diam. (vs. 3–5 mm diam.), with keeled (vs. rounded) valves, perforated (vs. complete) septum, and slightly shorter styles 0.2–0.7 mm (vs. 0.5–1.5 mm).

From *Lepidium chalepense* (southwestern and central Asia; naturalized in Argentina, Canada, and United States), *L. pabotii* differs by being a diminutive plant with decumbent (vs. erect) stems only 3–5 cm tall (vs. [15–]21–66[–92] cm tall), rosulate (vs. non-rosulate) basal leaves that are persistent (vs. withering early), non-auriculate (vs. sagittate-amplexicaul or auriculate) middle cauline leaves, fruiting pedicels 3–5 mm (vs. 8–19 mm) that are hirsute all around (vs. glabrous or sparsely puberulent adaxially), sepals 1.2–1.5 mm (vs.

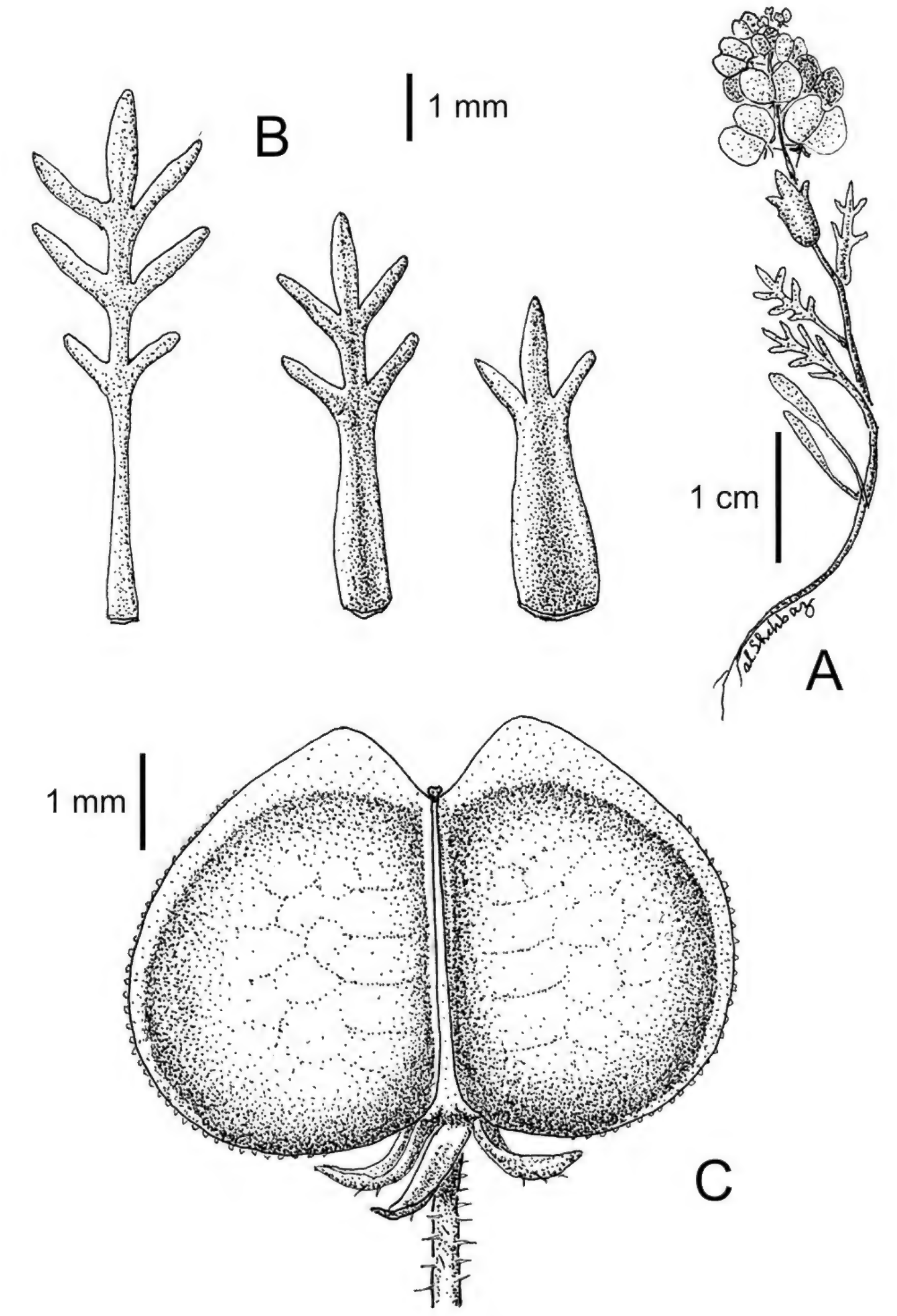

Figure 6. *Lepidium stephan-beckii* Al-Shehbaz. —A. Plant. —B. Cauline leaves (left to right: lower, middle, upper). —C. Fruit. Drawn by Al-Shehbaz from the holotype *S. G. Beck & M. Giorgetta 33939* (LPB).

1.7–3 mm), narrowly oblanceolate (vs. obovate) petals 2.2–2.5 × 0.5–0.6 mm (vs. 3–5 × 1.2–2.4 mm), and subglobose (vs. obovoid to subglobose or obcompressed-globose) fruit 2.5–3 mm diam. (vs. 3.5–5.8[–7] × [3.5–] 4–6.2[–7] mm) with hirsute (vs. glabrous) and keeled (vs. rounded) valves, a perforated (vs. complete or very

rarely perforated) septum, style 0.2–0.7 mm (vs. [0.8–] 1.2–2[–2.3] mm), one (vs. two) seeds per locule, and seeds 1.3–1.4 × 0.7–0.8 mm (vs. 1.5–2.3 × 1–1.3 mm).

In addition to the similarities above, *Lepidium pabotii* also resembles *L. propinquum* (Caucasus and adjacent Turkey) in having non-auriculate cauline leaves, keeled fruit, and one seed per locule. However, it differs in being hirsute (vs. glabrous) throughout, with decumbent (vs. erect) stems 3–5 cm tall (vs. 30–75 cm tall), narrowly oblanceolate (vs. obovate) petals, and inflated (vs. flattened) and globose (vs. orbicular) fruit with hirsute (vs. glabrous) valves and a perforated (vs. complete) septum.

5. Lepidium stephan-beckii Al-Shehbaz, sp. nov. TYPE: Bolivia. Dpto. Potosí: Prov. Sud Chichas, Wakawañusca, al Nor-Oeste en linea recta de Salo aprox. 11.71 km, puna seca con poca vegetación, sobre la loma esquistos, pajonales y matorrales de la puna xerofitica, 21°12′33″S, 65°51′33″W, 3990 m, 6 Mar. 2012, *S. G. Beck & M. Giorgetta 33939* (holotype, LPB!). Figure 6.

Diagnosis. *Lepidium stephan-beckii* Al-Shehbaz is unique among the South American congeners by having subdidymous, dehiscent fruit, apetalous flowers, and broadly expanded bases of upper cauline leaves.

Herbs annual. Trichomes simple, straight, acicular, 0.05–0.2 mm. Stems 2–5 cm, erect, simple, puberulent. Basal leaves not rosulate, soon withered, narrowly oblanceolate, 8–17 × 1–1.5 mm, entire, attenuate to a slender petiole to 9 mm; cauline leaves petiolate, non-auriculate, pinnatisect, 6–10 × 3–4 mm, glabrous; lateral lobes 2 or 3 on each side, narrowly oblong to entire, 1–3 × ca. 0.5 mm, subequal to terminal lobe, entire, petiole slender on lowermost leaves, conspicuously broadened and larger than blade on uppermost ones. Racemes ebracteate, corymbose, dense, slightly elongated in fruit; rachis puberulent as stem; fruiting pedicels 1.5–2.5 mm, puberulent all around, terete, narrowly winged, erect-ascending at base, slightly recurved and becoming divaricate distally, persistent. Sepals lanceolate, 1.3–1.5 mm, persistent, ascending in flower, spreading-reflexed in fruit, equal, sparsely puberulent; petals absent; stamens 2, equal in length, median; filaments 0.7–0.8 mm, glabrous, slender at base; anthers ovate, ca. 0.2 mm; nectar glands 4, distinct, median, 1 on each side of filament base, toothlike, ca. 0.15 mm. Fruit dehiscent, subdidymous, 4–4.5 × 5.5–6 mm, strongly angustiseptate, not inflated, apex emarginate, base subtruncate; valves papery, obscurely veined, glabrous except margin with trichomes 0.01–0.02 mm, smooth, strongly keeled; wing to 1 mm wide in distal half; apical notch widely V-shaped, 0.5–0.8 mm deep; septum complete; style obsolete, included in apical notch of fruit; stigma capitate, entire. Seeds 1 per locule, ovate, ca. 2 × 1.2 mm, narrowly margined; seed coat smooth; cotyledons incumbent, entire.

Distribution. *Lepidium stephan-beckii* is endemic to Bolivia (Potosí Dept.).

Etymology. The species epithet honors Stephan G. Beck (1944–), an expert on the flora of Bolivia who collected the new species and several other novelties of that flora.

Discussion. The holotype sheet is a mixed collection of 11 plants of *Lepidium stephan-beckii* and three of *L. pubescens* Desv. (southern Bolivia and north into central Peru). The two species resemble each other in indumentum, cauline leaves, puberulent fruit, persistent sepals, margined seeds, and presence of two median stamens. However, the novelty has simple stems, broadly expanded petioles of uppermost leaves, apetalous flowers, obsolete styles, and subdidymous fruit distinctly wider than long and with a truncate to shallowly emarginate base. By contrast, *L. pubescens* has stems branched above the base, slender petioles of all leaves, minute petals to 0.5 mm, minute styles 0.1–0.2 mm, and broadly ovate to obovate or suborbicular fruit longer than wide and with a broadly cuneate to obtuse base.

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What Is Philip Miller's "Perennial Moonwort," *Lunaria perennis* (Brassicaceae/Cruciferae)?

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ABSTRACT. The new combinations *Acuston perenne* (Mill.) Mabb. & Al-Shehbaz and *A. perenne* subsp. *obovatum* (Boiss. & Kotschy) Mabb. & Al-Shehbaz are proposed. The nomenclatural history, images of relevant types, and detailed descriptions of *Acuston* Raf. and *A. perenne* are provided for the first time.

Key words: *Acuston*, *Alyssum*, Brassicaceae, Cruciferae, *Farsetia*, *Fibigia*, *Lunaria*, *Pevalekia*.

One of us (Mabberley) has been working with David Moore (BM) on a catalogue of the taxonomic novelties by Robert Brown (Mabberley & Moore, 2007), including those currently attributed to Aiton (1812) as the authority for the *Hortus Kewensis* Cruciferae or Brassicaceae (published as Tetradynamia). A search for Brown's type specimens at BM herbarium led to the discovery of well-preserved cultivated material from Miller's herbarium carrying his name *Lunaria perennis* Mill. complete with Brown's annotation "Alyssum ~~orientale~~ lunarioides" and in pencil "Alyssum lunarioides." We have examined that sheet critically and conclude that Miller's epithet, which was not recognized or synonymized by subsequent authors, is the oldest basionym for a species variously assigned as "lunarioides" to several different genera during the past ca. 250 years. Names under which it has been known include *Acuston lunarioides* (Willd.) Raf. (Rafinesque, 1838; Španiel et al., 2015), *Alyssum lunarioides* Willd. (Willdenow, 1800; de Candolle, 1821), *Farsetia lunarioides* (Willd.) W. T. Aiton (Brown [anonymously] in Aiton, 1812; Boissier & Kotschy in Boissier, 1856), *Fibigia lunarioides* (Willd.) Sweet (Sweet, 1826; Smith in Sibthorp & Smith, 1831; Boissier, 1867; Post, 1896, 1932; Cullen, 1965; Mouterde, 1970; Phitos, 2002; Rešetnik et al., 2013), and *Pevalekia lunarioides* (Willd.) Trinajstić (Trinajstić, 1980). Therefore, a new combination in *Acuston* Raf. is needed, and the species is now to be known as *Acuston perenne* (Mill.) Mabb. & Al-Shehbaz.

As clearly demonstrated by Rešetnik et al. (2013) and Španiel et al. (2015), the species here named *Acuston perenne* belongs to tribe Alysseae and forms a clade independent of its other genera, with which, however, it shares dehiscent, latiseptate silicles, branched trichomes, accumbent cotyledons, and often yellow flowers. Although the plant was first assigned to *Lunaria* L. (tribe Biscutelleae), it differs substantially from that genus morphologically in having stellate (vs. simple) trichomes, free (vs. adnate to septum) funicles, yellow (vs. white to purple) flowers, and obsolete (vs. usually long) gynophores. It differs from *Farsetia* Turra (tribe Anastaticeae) in having stellate (vs. malpighiaceous) trichomes, veinless (vs. prominently veined) septa, and entire (vs. decurrently 2-lobed) stigmas. For differences from other genera of Alysseae, see the database of the tribe, AlyBase (<http://www.alysseae.sav.sk/>).

Except for Španiel et al. (2015), the monospecific genus *Acuston* has not been recognized in any recent taxonomic accounts, and no flora has a detailed description of it, though a short one is presented in AlyBase. Its single species was very briefly described (as *Fibigia lunarioides* (Willd.) Sweet) by both Cullen (1965) and Phitos (2002). Detailed descriptions and nomenclatural accounts of *Acuston* and its species are presented here for the first time.

Acuston Raf., Sylva Tellur. 131. 1838. TYPE: *Acuston lunarioides* (Willd.) Raf. (as "lunaroides"), Sylva Tellur. 131. 1838 [= *A. perenne* (Mill.) Mabb. & Al-Shehbaz].

Pevalekia Trinajstić, Suppl. Fl. Anal. Jugosl. 7: 10. 1980. TYPE: *Pevalekia lunarioides* (Willd.) Trinajstić, Suppl. Fl. Anal. Jugosl. 7: 11. 1980 [= *A. perenne*].

Subshrubs or perennial herbs with woody caudex, canescent, densely pubescent throughout. Trichomes sessile or subsessile, stellate, with 8 to 12 rather slender

straight rays, without webbing between the rays. Stems erect to ascending, woody, unarmed, many branched, branches terminating in sterile rosettes or leafy flowering shoots. Rosette leaves petiolate, simple, entire; cauline leaves sessile, cuneate to attenuate, not auriculate at base, entire. Racemes few (or rarely several)-flowered, ebracteate, corymbose, slightly elongated in fruit; rachis straight; fruiting pedicels divaricate to horizontal, straight or slightly curved, densely pubescent, persistent. Sepals oblong, free, deciduous, erect, unequal, base of lateral pair saccate; petals yellow, erect at base with flaring blade, longer than sepals; blade obovate to spatulate, apex obtuse; claw strongly differentiated from blade, ± equal to or longer than sepals, glabrous, unappendaged, entire; stamens 6, slightly exserted, erect, tetradynamous; filaments glabrous, free, median pairs winged to near apex, lateral pair winged to middle, unilaterally toothed at wing apex; anthers oblong; nectar glands 4, 1 on each side of lateral stamens; ovules 8 per ovary; placentation parietal. Fruit dehiscent, capsular silicles, obovate-oblong to suborbicular, strongly latiseptate, not inflated, unsegmented; valves thickened, subleathery, veinless, densely pubescent outside, glabrous inside, not keeled, smooth, wingless, unappendaged; gynophore obsolete; replum rounded, concealed by connate valve margins; septum complete, membranous, veinless; style pubescent along proximal 1/2, distal 1/2 caducous; stigma capitate, strongly 2-lobed, lobes connivent, decurrent, opposite replum, unappendaged. Seeds biseriate, winged all around, suborbicular, strongly flattened; seed coat not mucilaginous when wetted; cotyledons accumbent.

Acuston perenne (Mill.) Mabb. & Al-Shehbaz, comb. nov. Basionym: *Lunaria perennis* Mill., Gard. Dict., ed. 8, [p. LUN-LUP], Lunaria No. 4. 1768. TYPE: Greece. "Alyssum ~~ovatum~~ lunarioides. Greca," Herb. Miller (holotype, BM-000582910!). Figure 1.

Alyssum lunarioides Willd., Sp. Pl., ed. 4, 3: 461. 1800. *Farsetia lunarioides* (Willd.) W. T. Aiton, Hort. Kew., ed. 2, 4: 96. 1812 [the work of R. Brown, but unacknowledged on this page]. *Fibigia lunarioides* (Willd.) Sweet, Hort. Brit., 467. 1826. *Acuston lunarioides* (Willd.) Raf., Sylva Tellur. 131. 1838, as "lunaroides." *Pevalekia lunarioides* (Willd.) Trinajstić, Suppl. Fl. Anal. Jugosl. 7: 11. 1980. TYPE: (lectotype, designated by D. Phitos [2002: 225], B-WILLD # 11947!).

Lunaria graeca Willd., Enum. Pl. [Willdenow] 2: 675. 1809, nom illeg. [listed *Alyssum lunarioides* as a synonym].

Stems 3–15 cm, compactly or sometimes loosely branched below, densely covered with deciduous leaves. Rosette leaves narrowly oblanceolate, 1.5–3.5 cm × 3–7 mm, petiole 3–15 mm. Racemes 2- to 5(to 8)-flowered, 1–3(–5) cm in fruit; fruiting pedicels (1–)4–15 mm. Sepals 4–7 mm, moderately pubescent; petals 10–15 × 3–5 mm; claw 4–8 mm; filaments 4–7 mm; anthers 1–2 mm. Fruit 13–20(–25) × 10–13 mm; style 1–4 mm, stout. Seed (including wing) 7–8 × 5.5–6.5 mm; wing 2–3 mm wide distally. $2n = 16$ (Phitos, 2002).

Habitat. *Acuston perenne* occurs on limestone cliffs and rock crevices to 350 m in the Aegean Islands and to 2000 m in Syria.

Distribution. *Acuston perenne* is distributed in Greece (southeast Aegean area ranging from west Rodos and the islets of Dragonada, Gianisada, and Paimada off Kriti, Kriti, and Karpathos island groups, East Aegean Islands, and Kiklades Islands), and disjunctly into Syria (Anti-Lebanon).

Discussion. The Syrian plants have longer fruits, shorter fruiting pedicels, and slightly smaller sepals compared to those in Greece. Because of these differences and the substantial geographic disjunction (ca. 1000 km) between the Aegean and Syrian populations, the Syrian plants are here recognized as a distinct subspecies of *Acuston perenne*. The two subspecies are quite similar in all characters except for qualitative differences listed in the following key. Further data would be needed to justify recognizing them as distinct species.

KEY TO SUBSPECIES OF *ACUSTON PERENNE*

1a. Fruit 13–18(–20) mm; sepals 6–7 mm; fruiting pedicels 5–12 mm; Aegean Islands . . . . . subsp. *perenne*

1b. Fruit 20–25 mm; sepals 4–5 mm; fruiting pedicels 1–4 mm; Syria...subsp. *obovatum* (Boiss. & Kotschy) Mabb. & Al-Shehbaz

Acuston perenne subsp. **obovatum** (Boiss. & Kotschy) Mabb. & Al-Shehbaz, comb. et stat. nov. Basionym: *Farsetia obovata* Boiss. & Kotschy, Diagn. Pl. Orient. ser. 2, 5: 27. 1856. *Fibigia obovata* (Boiss. & Kotschy) Boiss., Fl. Orient. [Boissier] 1: 258. 1867. *Fibigia clypeata* (L.) Medik. var. *obovata* (Boiss.) Post, Fl. Syr. Leb. Palest. 81. 1896. TYPE: [Syria]. "Circa Zebdaine, prope Damascum. Farsetia obovata Boiss. et Kotschy. n. sp. In jugis frigidis inter Bludan et Halbun pagum," 6500 ft., 17 June 1855, *Kotschy 142* (lectotype, designated here, G-BOIS-00332308!; isolectotypes, B-10_0241465!, E-00373134!, G-BOIS-00332309!, GZU-000273463!, K-000618642!, MPU-017097!, P-00747701!, P-06618104!, P-06618105!). Figure 2.

Alyssum petalodes DC., Syst. Nat. [Candolle] 2: 312. 1821. TYPE: Hab. in Syria, 1819, *Labillardiere s.n.* (holotype, P!; isotypes, G-00371675!, GDC-00205585!).

Figure 1. Holotype of *Lunaria perennis* Mill. and *Acuston perenne* (Mill.) Mabb. & Al-Shehbaz.

Discussion. The original locality is described in the protologue of *Farsetia obovata* as "Hab. in alpinis *Manschura* [now Mansura] Antilibani, cl. Kotschy," and in the protologue of *Fibigia obovata* as "Hab. in jugis frigidis Antilibani supra Bludan alt. 6300' (Ky exs. 152!)." There are two sheets of *Farsetia obovata*/*Fibigia obovata* in a single collection folder at G-BOIS, which indicates that they represent one collection, as for other collections in Boissier's herbarium. One of us (Al-Shehbaz) examined all of the *Flora Orientalis* Brassicaceae in Boissier's herbarium, and no mixed collections were found in a given collection folder. One sheet has four clusters, of which the one on the top right has the printed label "Th. Kotschy. Iter Syriacum 1855–Circa Zebdaine prope Damascum. 142. Farsetia obovata Boiss. et Kotschy. n. sp. In jugis frigidis inter Bludan et Halbun pagum alt. 6500 ped. Die 17. Jun." Duplicates of this collection are housed at B, E, GZU, K, KW, MPU, and P. Their printed label is the closest match to the locality described in the protologue of

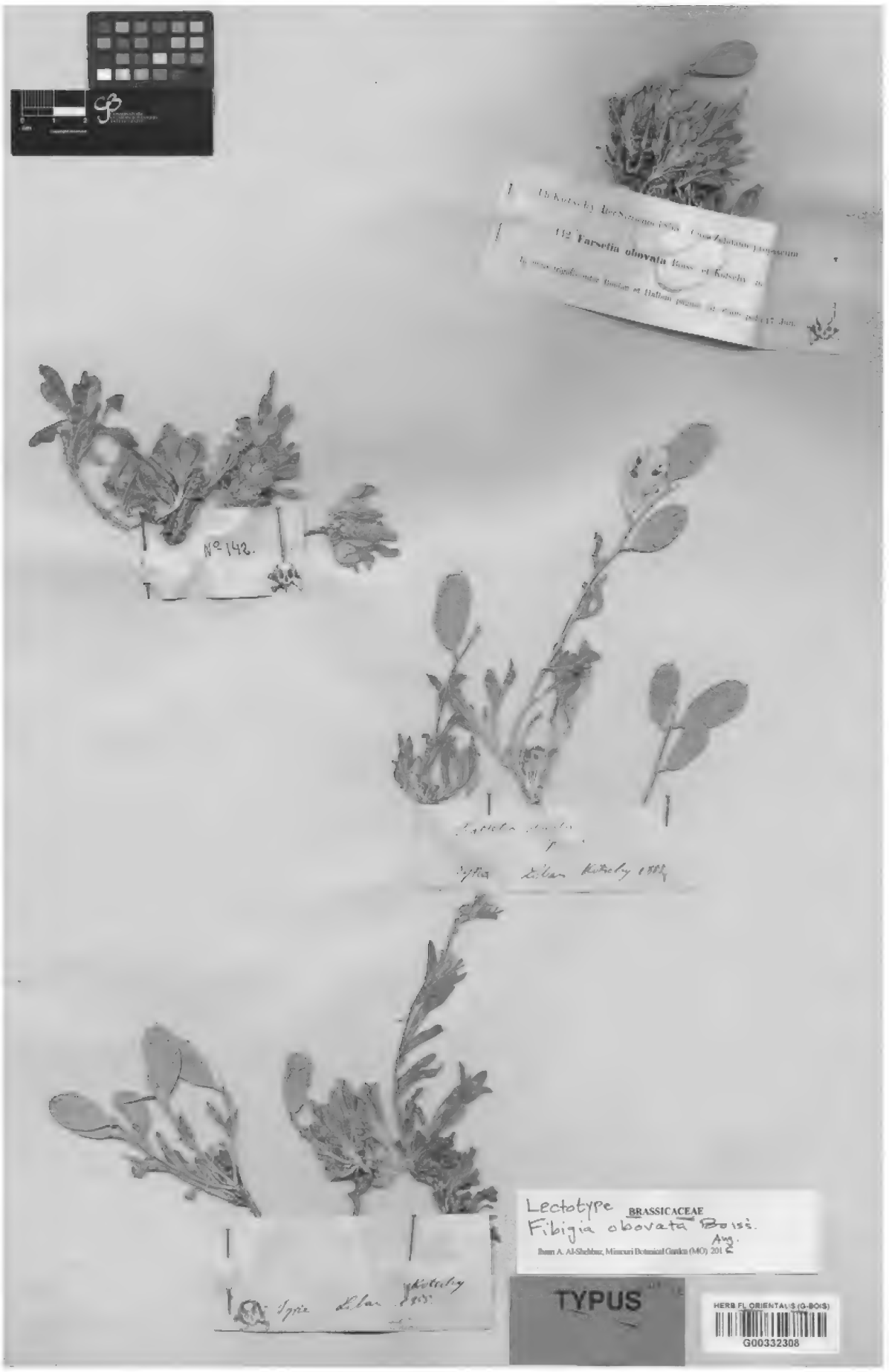

Figure 2. Lectotype of *Farsetia obovata* Boiss. & Kotschy and *Acuston perenne* (Mill.) Mabb. & Al-Shehbaz subsp. *obovatum* (Boiss. & Kotschy) Mabb. & Al-Shehbaz.

Fibigia obovata. However, we did not find anywhere a single sheet of that collection with the name *Fibigia obovata*, collection number *152*, or elevation 6300 ft. Such inaccuracies in Boissier's original publication in *Flora Orientalis* are not uncommon. The second cluster on the left of the above sheet has a label carrying only *142*. The middle and lower clusters have handwritten labels by Boissier that read "Farsetia obovata sp. nov. Syrie Liban Kotschy 1855" and "Syrie Liban Kotschy 1855," respectively. The second sheet has a label without a species name, and its label reads "Syrie Liban Kotschy 1855." None of the above collections of *Farsetia obovata* has the locality "Manschura," which is "Mansoura," and all localities listed in the original protologues of *Farsetia obovata* and *Fibigia obovata* are in the Anti-Lebanon Mountains to the north-northwest of Damascus.

One might argue that *Farsetia obovata* and *Fibigia obovata* are based on different collections. However,

despite the failure by Boissier (1867) to provide a reference to his earlier work (Boissier, 1856) and the name *Farsetia obovata*, his use of the same species epithet, his distribution of all duplicates as *Farsetia obovata* (not *Fibigia obovata*), his original recognition of all *Fibigia* Medik. species as *Farsetia* in earlier works, his filing in one collection folder of all duplicate sheets of a single collection, the lack in all herbaria of any plant originally labeled as *Fibigia obovata*, and his rather broad and sometimes vague locality citations in this and some other works are in our opinion clues that he was dealing with a single collection. Therefore, we argue that *Fibigia obovata* is a combination based on *Farsetia obovata*.

Excluded Names

Acuston ? clypeatum (L.) Raf., Sylva Tellur. 131. 1838 [≡ *Fibigia clypeata* (L.) Medik., Pfl.-Gatt., 91. 1792, type of *Fibigia*].

Rafinesque (1838) was uncertain about the generic placement of *Acuston clypeatum* and suggested its placement in the subgenus *Plagidon* Raf., a name that was never accepted by subsequent botanists.

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Validation of *Thinopyrum turcicum* and *T. varnense* (Poaceae, Pooideae, Triticeae)

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ABSTRACT. The nomenclaturally correct names of two specific epithets of the economically important *Thinopyrum* Á. Löve, related to bread wheat, are given and explained.

Key words: Poaceae, *Thinopyrum*.

Thinopyrum Á. Löve (Poaceae, Pooideae, Triticeae) contains species that are potential sources of germplasm for wheat improvement, including genes for traits such as disease resistance, and salt and drought tolerance (De Pace et al., 2011). Thus *Thinopyrum* and related genera are valuable reservoirs of potential genes for the breeder. Wide crosses between wheat and such wild relatives can lead to the formation of amphidiploids (Nemeth et al., 2015), and introgression into commercial cultivars of wheat can ensue (see a summary in Wang, 2011). These two new combinations resulted from our molecular work on *Thinopyrum* (Baum & Johnson, 2017).

Thinopyrum turcicum (P. E. McGuire) B. R. Baum & D. A. Johnson, comb. nov. Basionym: *Elytrigia turcica* P. E. McGuire, Folia Geobot. Phytotax. 18: 108. 1983. *Elymus elongatus* (Host) Runemark subsp. *turcicus* (P. E. McGuire) Melderis, Notes Roy. Bot. Gard. Edinburgh 42: 81. 1984. *Lophopyrum turcicum* (P. E. McGuire) P. E. McGuire ex Á. Löve, Feddes Repert. 95: 489. 1984. *Elytrigia pontica* (Podp.) Holub subsp. *turcica* (P. E. McGuire) Jarvie & Barkworth, Nordic. J. Bot. 12: 162. 1992. *Elytrigia elongata* (P. Beauv.) Nevski subsp. *turcica* (P. E. McGuire) Valdés & H. Scholz, Willdenowia 36: 661. 2006. TYPE: Turkey. 16 km W of Bor, Nigde, *J. R. Harlan 9269*, grown in the greenhouse from seed collected as *Agropyron elongatum* (Host) P. Beauv. PI149162 (AHUC [barcode] AHUC38150 as image!).

Discussion. This taxon was first described by McGuire (1983) as *Elytrigia turcica*. It had been collected in 1980 by Harlan in Turkey as seed material labeled *Agropyron elongatum* and then grown by McGuire who subsequently made chromosome counts leading to Löve (1984) publishing the combination *Lophopyrum turcicum*. Cabi (2010) attempted to publish the combination "*Thinopyrum elongatum* (Host) D. R. Dewey subsp. *turcicum* (P. E. McGuire) Cabi & M. Doğan" in a Ph.D. dissertation, but this and other combinations in that work were not effectively published. In our view, the taxon should be recognized as a distinct species within *Thinopyrum*. An earlier attempt to publish this combination, "*Thinopyrum turcicum* (P. E. McGuire) Zhi W. Liu & R. R.-C. Wang" (Liu & Wang, 1993), was not validly published through failure to provide a full reference to the place of publication of the basionym; it was wrongly stated to have been published in volume 8, page 171.

Thinopyrum varnense (Velen.) B. R. Baum & D. A. Johnson, comb. nov. Basionym: *Triticum varnense* Velen., Sitzungsber. Königl. Böhm. Ges. Wiss., Math.-Naturwiss. Cl. 29: 28. 1894. *Agropyron varnense* (Velen.) Hayek, Repert. Spec. Nov. Regni Veg. Beih. 30: 222. 1932. ["*Elymus varnensis* (Velen.) Runemark," Hereditas (Lund) 70: 156. 1972, nom. inval.] *Elytrigia varnensis* (Velen.) Holub, Folia Geobot. Phytotax. 12: 426. 1977. *Elymus hispidus* (Opiz) Melderis subsp. *varnensis* (Velen.) Melderis, Bot. J. Linn. Soc. 76: 381. 1978. *Trichopyrum varnense* (Velen.) Á. Löve, Veröff. Geobot. Inst. Rübel 87: 49. 1986 ["*Elymus varnensis* (Velen.) Kožuharov," Opred. Vissh. Rast. Bulg.: 785. 1992, nom. inval.] *Elytrigia intermedia* (Host) Nevski subsp. *varnensis* (Velen.) Valdés & H. Scholz, Willdenowia 36: 661. 2006. TYPE: "In arenosis ad Pontum prope Varnum et Kebedz legi 8. 1885," *Velenovsky* (holotype, PRC [barcode] 451062 not seen).

Agropyron incrustatum Adam., Denkschr. Kaiserl. Akad. Wiss., Wien. Math.-Naturwiss. Kl. 74: 119. 1904. TYPE: Macedonia. "[I]n graminosis siccis ad Voden (*Kindl*) et Bitolj (*Pilcz*)," [*Bierbach?*] (syntypes, B? as images!).

Discussion. The name *Trichopyrum varnense* (Velen.) Á. Löve was recently adopted by Yen and Yang (2013). Typification of the taxonomic synonym *Agropyron incrustatum* is unclear. The protologue mentioned collections from Voden and Bitolj [Bitola], respectively credited to Kindl and Pilcz. JSTOR Plants (<www.plants.jstor.org>) lists as presumed isotypes two specimens at B collected by Bierbach in May 1904. One is numberless and has a

handwritten label indicating that it is from Macedonia "in graminosis ad Manastir," while the other, given the number 531, has a printed label that gives the bibliographic data for *A. incrustatum* and says "An grasigen, trockenen Stellen bei Voden in Südmacedonien … 500 m." Manastir is the Turkish name for Bitolj. Hence it seems likely that these are the cited syntypes, inaccurately credited in the protologue. Adamović's publication (1904), printed on an undetermined date, states that it was presented in a session on 7 May 1903; however, additional species might have been added to the manuscript just before publication as new collections were made available to the author. Because it has not yet been possible to study these specimens nor to make a full search for other possible original material, we refrain from designating a lectotype at this time.

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Alectryon vitiensis: A New Species of Sapindaceae Endemic to Fiji

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Abstract. A new species of *Alectryon* Gaertn. (Sapindaceae) endemic to the Fijian archipelago is described as *A. vitiensis* Buerki, Lowry, Munzinger & Callm. based on morphological and molecular evidence. It can easily be distinguished from the two congeners currently known from Fiji by its smaller leaves, subsessile leaflets, apetalous flowers, and crested fruits. A phylogenetic analysis using ITS sequence data shows that the new species is closely related to two Australian endemics, *A. diversifolius* (F. Muell.) S. T. Reynolds and *A. oleifolius* (Desf.) S. T. Reynolds, but differs in having compound leaves covered with a golden indument. Moreover, the Australian taxa are associated with dry habitats, whereas the new species from Fiji is confined to evergreen humid forests. Among apetalous species (all of which belong to a well-supported clade), *A. vitiensis* morphologically most closely resembles the generic type, *A. excelsus* Gaertn., endemic to New Zealand, but they differ from one another in the type of indument covering their branches and leaves and the arrangement, shape, and nature of the indument on their leaflets; and they belong to different clades. The new species is provisionally assigned a conservation status of "Endangered" according to the IUCN Red List criteria.

Key words: *Alectryon*, conservation, Cupania group, IUCN Red List, molecular systematics, Pacific islands, Sapindaceae.

As part of a collaborative research program being conducted on the systematics, evolution, and biogeography of Sapindaceae in Southeast Asia (Buerki et al. 2013a, 2013b) and the Pacific islands (Buerki et al., 2012; Munzinger et al., 2013, 2016; Pierre et al., 2014), two field expeditions were conducted to the Fijian archipelago in 2011 and 2015 in order to collect material of the indigenous species and gain insights into their morphology and ecology as well as their relationships with other members of the family. During each of these trips, material was collected of a previously undescribed member of the genus *Alectryon* Gaertn. growing in humid evergreen forest on the island of Vanua Levu, initially in fruit and then, during the second expedition, in flower. Careful examination of the material deposited at SUVA enabled us to match these collections with an earlier flowering specimen (*Dept. of Agriculture 19647*) gathered in 1986 on the island of Viti Levu. In the most recent treatment of Fijian Sapindaceae (Smith, 1985), two species of *Alectryon* were recognized, *A. grandifolius* A. C. Sm.

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and *A. samoensis* Christoph. The first of these is endemic to the two largest Fijian islands, Viti Levu and Vanua Levu, whereas the second species has been recorded in Fiji only once by Smith (1985) (a fruiting collection made on limestone from Kambara Island) and is otherwise known only from Samoa, where it is reported to be rare and restricted to the island of Savai'i (Smith, 1985). These two species can easily be distinguished from one another by leaf length, the number and shape of leaflets, the length of petiolules, and fruit and seed size (Smith, 1985). The material of our new entity clearly differs from both *A. grandifolius* and *A. samoensis* by several characters of its leaves, flowers, and fruits, which has prompted us to examine it in detail in order to determine its taxonomic status.

Alectryon comprises ca. 25 to 30 species distributed from eastern Malesia, Australia, New Zealand, and New Caledonia across the Pacific to Hawaii (Buerki et al., 2009). Australia is the center of diversity, with 15 species (13 endemic; Edwards & Gadek, 2001), while 10 species are reported in the area covered by the Flora Malesiana project (Leenhouts, 1988; Adema et al., 1994), and the remainder of the diversity is spread across islands in the Pacific (see Table 1 in Edwards & Gadek, 2001, for a summary of the number of species per region). Edwards and Gadek (2001) published a phylogenetic study of *Alectryon* based on molecular sequence data, but their limited sampling from outside the genus precluded inferences regarding its position within Sapindaceae. Buerki et al. (2012), in a broad study with representation from throughout the family that included samples of 12 species of *Alectryon*, showed that the genus belongs to a clade they recognized as the "Cupania group," within which it was placed as sister to the endemic New Caledonian genus *Podonephelium* Baill. (see Munzinger et al., 2013, for more details on this genus). Their sampling did not, however, include any material from Fiji. To confirm that our new entity indeed belongs to *Alectryon* and to enable a preliminary assessment of its phylogenetic relationships within the genus, we have generated a nuclear ITS sequence for one of the collections (*Callmander et al. 941*) and added it to the dataset used by Buerki et al. (2012). We limited our sequencing to ITS because in previous studies this region yielded a majority of the nucleotide polymorphisms that differed among species of *Alectryon* (Edwards & Gadek, 2001; Buerki et al., 2009, 2012, 2013b), suggesting that this marker would provide ample information to confirm the generic placement and evaluate the relationships of our new material.

Based on detailed examination of the morphological features of the material of *Alectryon* collected in Fiji and a careful comparison with other members of the genus, we have concluded that this entity is sufficiently distinct to warrant description as a new species, which we describe below as *A. vitiensis* Buerki, Lowry, Munzinger & Callm. Using information from the expanded molecular phylogenetic analyses, we also discuss the affinities of this new species within the genus and explore how phylogenetic relationships align with selected morphological characters. The new species is provided with a line drawing, color photos, and a preliminary risk of extinction assessment using the *IUCN Red List Categories and Criteria* (IUCN, 2012).

Materials and Methods

DNA extraction, amplification, and sequencing

Genomic DNA of *Callmander et al. 941* was extracted from silica-gel–dried leaf material following the same

Table 1. Comparison of *Alectryon vitiensis* Buerki, Lowry, Munzinger & Callm. with its phylogenetically most closely related species (*A. diversifolius* (F. Muell.) S. T. Reynolds and *A. oleifolius* (Desf.) S. T. Reynolds), species occurring in Fiji (*A. grandifolius* A. C. Sm. and *A. samoensis* Christoph.), and the most morphologically similar species (*A. excelsus* Gaertn.). See text for more details.

	A. vitiensis	*A. diversifolius*	*A. oleifolius*	*A. grandifolius*	*A. samoensis*	*A. excelsus*
Corolla	absent	absent	absent	present	present	absent
Leaf type	compound	simple	simple	compound	compound	compound
Phyllotaxy of leaflets	opposite	N/A	N/A	opposite	opposite to subopposite	alternate (sometimes subopposite when young)
Leaf surface	with golden indument	glabrous	with white indument	rapidly glabrous	rapidly glabrous	with ferruginous indument
Fruit crests	present	absent	weakly developed	absent	absent	present
Geographic distribution	Fiji	Australia	Australia	Fiji	Fiji and Samoa	New Zealand
Phylogenetic position	clade BI	clade BI	clade BI	not evaluated	not evaluated	clade BIII

modified 2× CTAB method used by Buerki et al. (2009). A nuclear ITS sequence was then produced following the same primers and polymerase chain reaction (PCR) and sequencing protocols described in Buerki et al. (2009).

DNA sequence alignment and phylogenetic analyses

The program Geneious 8.1.3 (Biomatters, Auckland, New Zealand) was used to assemble complementary strands and verify software base-calling. The sequence of *Callmander et al. 941* (GenBank accession number KY454869) was aligned using MUSCLE (implemented in Geneious; Edgar, 2004) into the ITS dataset of Buerki et al. (2012), which includes all the available sequences of *Alectryon* (representing a total of 12 species). Identifications of species of *Podonephelium* sampled in Buerki et al. (2012) have been updated based on taxonomic results of Munzinger et al. (2013). Phylogenetic inferences were carried out employing both maximum likelihood (ML) and Bayesian Markov chain Monte Carlo (MCMC) analyses, performed using the facilities offered by the CIPRES portal in San Diego, California, U.S.A. (<http://www.phylo.org/>). The ML analysis was done using RAxML 8.1.11 (Stamatakis, 2006; Stamatakis et al., 2008) with a 1000 rapid bootstrap analysis followed by the search of the best-scoring ML tree in a single run. The default model, GTRCAT, was used to perform the ML analysis. The Bayesian MCMC analysis was performed in MrBayes 3.2 (Ronquist et al., 2012) and the best-fit model (GTR+G) was estimated using MrModeltest 2.3 (Nylander, 2004) and the Akaike information criterion (Akaike, 1974). Three Metropolis-coupled Markov chains with an incremental heating temperature of 0.2 were run for 10 hours on the CIPRES portal yielding 7,802,000 generations and sampled every 1000th generation. Each analysis was repeated twice starting with random trees. The MCMC sampling was considered sufficient when the effective sampling size was higher than 200, as verified in Tracer 1.4 (Rambaut & Drummond, 2007). After a burn-in period of 25% per run, the remaining trees were used to construct a majority-rule consensus tree and its associated Bayesian posterior probabilities (BPP).

Morphology

In order to identify potentially informative morphological characters of the new entity of *Alectryon* and to assess its affinities with other members of the genus, material deposited in the following herbaria was examined: BM, G, K, MO, MPU, NOU, P, and SUVA. This was complemented by accessing digital images of type specimens through the Global Plants website (<http://plants.jstor.org/>), especially for Pacific island species with types at BISH and US. To encompass the full range of morphological variation of species across their distributional ranges, we also consulted the descriptions provided in several floras (Cheeseman, 1925; Reynolds, 1985; Smith, 1985; Adema et al., 1994). Data were compiled on key morphological characters for each taxon. The terminology used here follows Beentje (2016).

Species distribution map and conservation assessment

GPS coordinates were available for all collections except *Dept. of Agriculture 19647*, which was geolocalized a posteriori using Google Earth (freely available at <http://www.google.com/earth/>). A species distribution map was prepared using ArcGIS 10.3.1 software by ESRI, using the Fiji_Coast_BND shape file provided by ArcGIS REST Services Directory (<http://services3.arcgis.com>). The preliminary risk of extinction assessment of our new taxon was assessed using the *IUCN Red List Categories and Criteria* (IUCN, 2012). The extent of occurrence (EOO) and area of occupancy (AOO) were calculated by using the GeoCAT tool (Bachman et al., 2011) with a grid cell size of 2 × 2 km used to calculate AOO.

Results

Phylogenetic analyses

The ML and Bayesian analyses based on ITS data yielded congruent overall tree topologies and inferred the same phylogenetic position for the sample of our new entity. Only the Bayesian majority-rule consensus tree is presented here (Fig. 1), but we have also indicated the bootstrap support (BS) values obtained from the RAxML analysis. The monophyly of *Alectryon* is confirmed with strong support (BPP: 1.00, BS: 99%), although its sister relationship with the New Caledonian endemic *Podonephelium* is only moderately supported by the ITS data alone (BPP: 0.79; BS: 78%). Within *Alectryon*, two moderately to well-supported clades are recovered (Fig. 1), clade A (BPP: 0.84, BS: 63%), comprising species whose flowers have petals, and clade B (BPP: 1.00, BS: 96%), all of whose members are apetalous. Three subclades are retrieved within clade B with varying levels of support (subclades BI, BII, and BIII), although the relationships among them are not resolved in the tree based on ITS data. The inclusion of the sample of the new taxon from Fiji within *Alectryon* is strongly supported by the molecular data, and it is placed in subclade BI, sister to two other apetalous species, *A. diversifolius* (F. Muell.) S. T. Reynolds and *A. oleifolius* (Desf.) S. T. Reynolds, both endemic to Australia (Fig. 1).

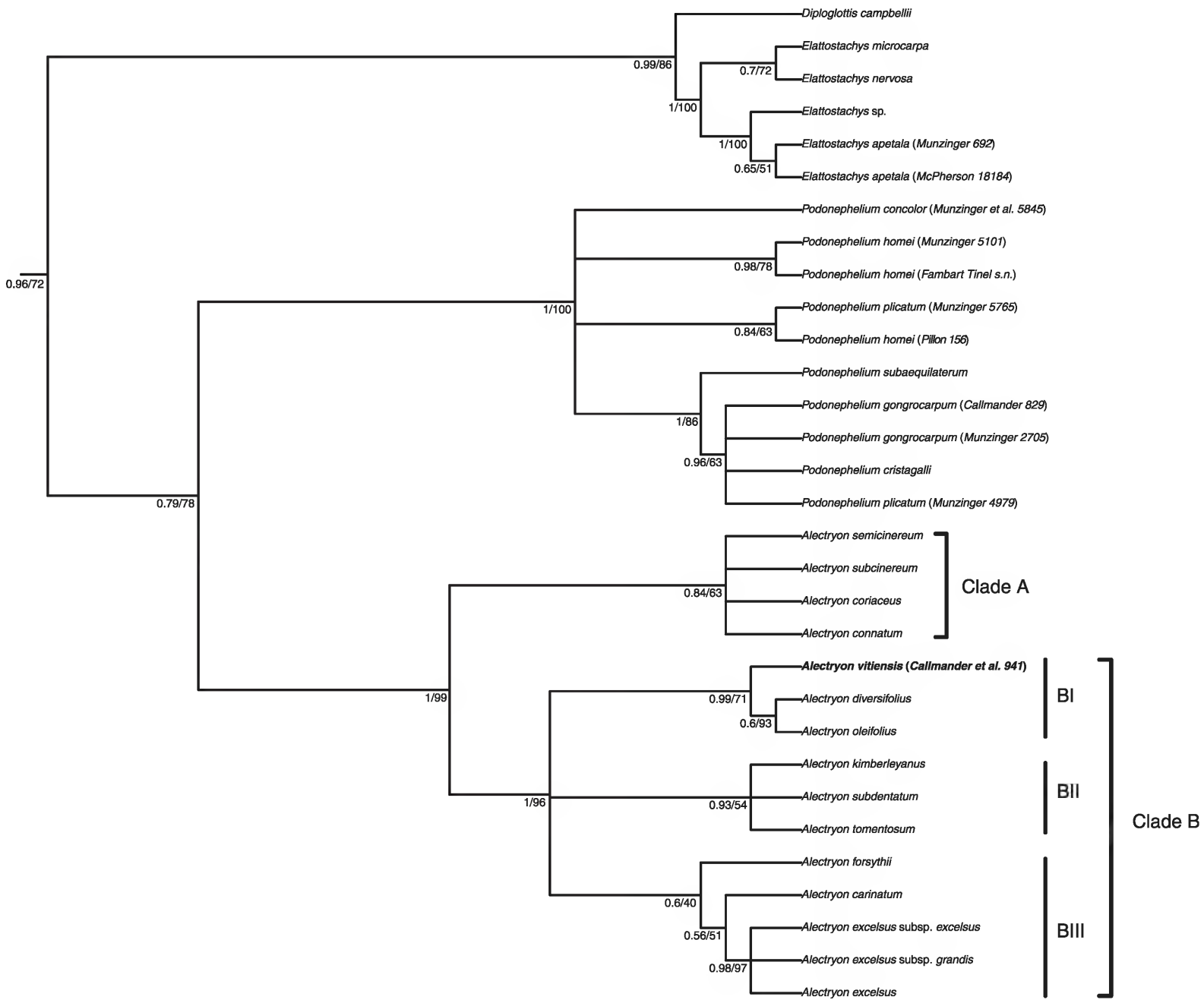

Figure 1. Bayesian half-compatible consensus tree of Sapindaceae inferred from the nuclear ITS region focusing on the phylogenetic position of *Alectryon vitiensis* Buerki, Lowry, Munzinger & Callm. (*Callmander et al. 941*). Bayesian posterior probabilities (BPP) and bootstrap support (BS) values are displayed at nodes. See main text for the discussion of the clades within *Alectryon* Gaertn.

MORPHOLOGY

The phylogenetic inferences presented above indicate that, among the taxa included in our sampling, our material is most closely related to two Australian species of *Alectryon* (*A. diversifolius* and *A. oleifolius*). While this result should be regarded as preliminary because we do not yet have comprehensive sampling from within the genus, including the two currently recognized species from Fiji (*A. grandifolius* and *A. samoensis*), it nevertheless provides a useful framework for comparing morphological features. Drawing on our observations of herbarium material (including scans of type specimens) and information gathered from the published literature, we compiled an extensive list of morphological characters in order to compare our new entity with an appropriate set of currently recognized species (see Table 1). These include the two currently recognized species present in Fiji as well as the two taxa included in the phylogenetic study to which our novelty appears most closely related (*A. diversifolius* and *A. oleifolius*). Moreover, because the overall morphology of our new taxon most closely resembles that of the generic type, *A. excelsus* Gaertn., which is endemic to New Zealand, we also included it in the comparison, despite the fact that our phylogenetic analyses placed it in a different subclade within the apetalous clade B (Fig. 1).

Our new taxon can easily be distinguished from its apparent close relatives, *Alectryon diversifolius* and *A. oleifolius*, by its compound (vs. simple) leaves covered with a golden indument (vs. glabrous in *A. diversifolius* and with a white indument in *A. oleifolius*). The new entity differs from the two other species present in Fiji, *A. grandifolius* and *A. samoensis*, not only by being

apetalous, but also by having leaflets that are shorter (11–19 cm vs. 45–90 cm in *A. grandifolius* and 30–40 cm in *A. samoensis*) and nearly subsessile (vs. petiolules 15 mm in *A. grandifolius* and > 10 mm in *A. samoensis*), along with crested fruits (vs. smooth in the other two taxa). Finally, while our new taxon shares apetalous flowers and crested fruits with *A. excelsus*, these two entities can easily be distinguished by the color of the indument covering their branches and leaves (golden in the novelty from Fiji vs. ferruginous in *A. excelsus*) as well as several aspects of their leaflets, including their arrangement (opposite in the new taxon vs. alternate in *A. excelsus*) and shape (elliptic vs. obliquely ovate-lanceolate), and the distribution of the golden indument (covered throughout vs. restricted to the venation below and glabrous on the upper surface).

Discussion

The results of our phylogenetic analyses agree with those of Edwards and Gadek (2001) in supporting the subdivision of *Alectryon* into two main clades characterized by flower morphology, one (clade A) in which the species have flowers with an evident corolla and another (clade B) that exclusively comprises apetalous species (Fig. 1). Unfortunately, we have not been able to sequence either of the two currently recognized species of *Alectryon* occurring in Fiji. We can, however, hypothesize that, based on the presence of a fully developed corolla in both *A. grandifolius* and *A. samoensis*, they would belong to clade A. This hypothesis will have to be tested by including these species in a further expanded phylogenetic analysis, but the morphological evidence presented here strongly supports the conclusion that the newly collected material of *Alectryon* from Vanua Levu and the older collection of the same entity from Viti Levu do not belong to either of the previously described species in Fiji.

Our sample of the new taxon from Fiji is placed within a subclade of clade B that also includes two Australian species (Fig. 1), both of which were originally described in the genus *Heterodendrum* Desf. based on the presence of simple leaves and apetalous flowers (Reynolds, 1985) but were subsequently transferred to *Alectryon* by Reynolds (1987), a decision later confirmed by molecular phylogenetic evidence (Edwards & Gadek, 2001; Buerki et al., 2012). While our collections of the new *Alectryon* from Fiji share apetalous flowers with these two Australian species, as indicated above, they can easily be distinguished on the basis of several morphological characters (Table 1). Furthermore, these two Australian taxa occur in dry habitats, viz. in brigalow scrub in the case of *A. diversifolius* and mixed woodland for *A. oleifolius*, according to Reynolds (1985), whereas the new Fijian species is known only from lowland evergreen humid forest.

Finally, while our new species resembles the New Zealand endemic *Alectryon excelsus* (Table 1), the phylogenetic inferences resulting from our analyses of ITS sequence data show that these two taxa are not closely related (Fig. 1). Our taxonomic novelty belongs to subclade BI, whereas *A. excelsus* is placed in subclade BIII, where it is sister to the New Caledonian endemic *A. carinatum* Radlk. (Fig. 1).

The evidence provided above clearly supports the recognition of the material from Fiji as a new species, which we describe below as *Alectryon vitiensis*. We accompany the formal description of this novelty with additional information on its habitat and conservation status.

Taxonomy

Alectryon vitiensis Buerki, Lowry, Munzinger & Callm., sp. nov. TYPE: Fiji. Vanua Levu: Macuata Prov., Tikina Wailevu Region, Yavusa Sauniduna, Lambasa, near Nasaqa village, 16°33′24″S, 179°18′53″E, 500 m, 10 Feb. 2011, fr., *Callmander et al. 941* (holotype, G [barcode] G00341663!; isotypes, BM!, MO-6703556!, MPU [bc] MPU310596!, SUVA!).

Diagnosis. *Alectryon vitiensis* Buerki, Lowry, Munzinger & Callm. differs from other members of the genus by a combination of (11–)12–19-cm-long paripinnately compound leaves with opposite, subsessile leaflets bearing golden indument on the veins; lateral racemose inflorescences densely covered with golden indument; apetalous flowers with a villous calyx outside, and 1- to 2-lobed, crested fruits.

Tree, 3–8 m tall, trunk 8 cm diam., monoecious (or possibly andromonoecious); bark smooth, gray; branches ca. 3.5–6 mm diam. just below insertion of mature leaves, blackish, covered with golden indument. Leaves alternate, paripinnate, (11–)12–19 cm; petiole (2–)5.5 cm, ca. 1.5–2(–3) mm diam. at base, hirsute to sericeous; leaflets (4 to)5 to 7 pairs, opposite, blades medium to dark green on both surfaces (upper surface slightly darker), papyraceous, elliptic, 4–7 × 1.2–3.5 cm, venation hirsute to sericeous with golden indument, base subcordate to cordate, margins entire, rarely slightly dentate distally when young, apex acute; petiolules very short, < 1 mm, slightly enlarged at the base. Inflorescence a lateral compound raceme, with solitary flowers or spikelets, or secondarily producing solitary flowers or spikelets by reinitiation in the axils of bractlets, 5–9 cm, hirsute with golden indument. Male flowers ca. 1.5–3 mm, borne singly or in pairs;

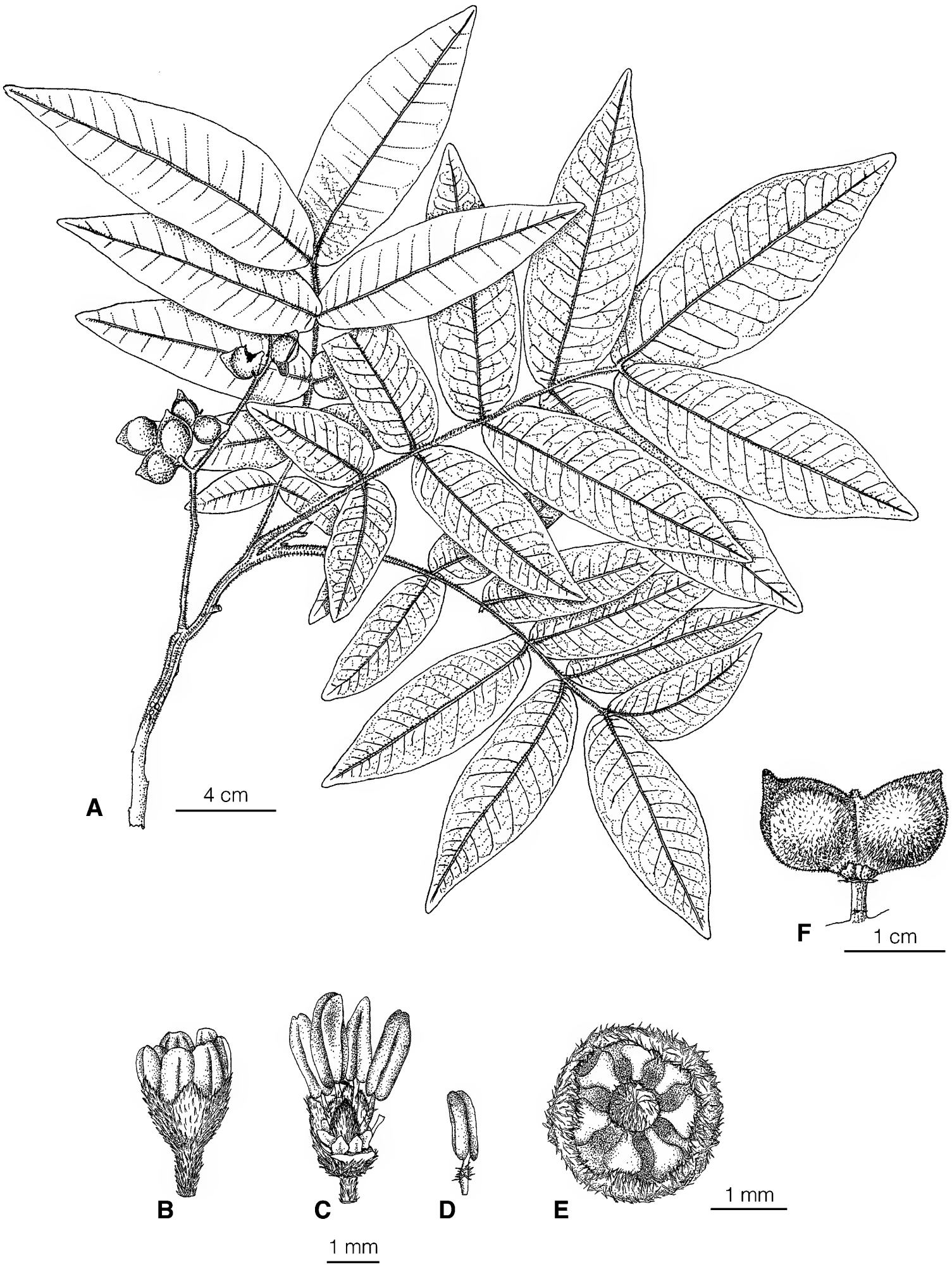

Figure 2. *Alectryon vitiensis* Buerki, Lowry, Munzinger & Callm. —A. Fruiting branch. —B, C. Flower. —D. Stamen. —E. Disk. —F. Pistillate spikelet. A, F based on *Callmander et al. 941* (MPU); B–E based on *Munzinger et al. 7376* (MPU). Drawn by L. Ramon.

bracts subtending the inflorescence axes linear or narrowly triangular, 2–3 mm, caducous, leaving an evident scar; pedicels 1–2.5 mm, shortly sericeous. Calyx cupuliform, toothed, lobes (4 to)5 to 6, triangular, 0.5 mm, greenish in vivo, brown in sicco, villous outside, puberulent inside. Petals absent. Disk present, ca. 1 mm diam., forming separate T-shaped portions equal in number to stamens. Stamens 3 to 6; filaments 0.5 mm at anthesis, shortly villous in upper half; anthers cream-colored, ca. 1.5 mm. Ovary vestigial, conical, ca. 0.5 mm high, densely sericeous. Female (or possibly hermaphroditic) flowers not seen.

Figure 3. Photographs of *Alectryon vitiensis* Buerki, Lowry, Munzinger & Callm. —A. Flowering branch. —B. Detail of flowers. —C, D. Fruiting branch. A, B from *Munzinger et al.* 7376; C from *Callmander et al. 941*; D from *Callmander et al. 945*. A, B photos by P. Lowry; C, D photos by M. W. Callmander.

Fruit 1- to 2-lobed, ca. 0.8–1.5 × 1–1.8 cm, narrowed to the base, crested, puberulent to hirsutulous; exocarp 0.2 mm thick, inner surface of locules glabrous; seed with a translucent arillode when young. (See Figs. 2 and 3 for more details on the morphology of *Alectryon vitiensis*.)

Etymology. The epithet refers to the distribution of the species, which is only known from the islands of Vanua Levu and Viti Levu in the Fijian archipelago.

Habitat, distribution, and phenology. *Alectryon vitiensis* is only known from Vanua Levu and Viti Levu, the two largest islands in the Fiji archipelago (Fig. 4). It occurs in evergreen humid forest ranging between 110 and 550 m in elevation. Flowering material has been collected in March and November, whereas the fruiting collections were made in February (see Figs. 2, 3).

IUCN Red List category. With an EOO of 431.6 km^2, an AOO of 16 km^2, and three subpopulations representing three locations with respect to the main threat (logging), none of which are situated within Fiji's protected areas network and all of which are projected to face continuing decline in quality of habitat, *Alectryon vitiensis* is assigned a preliminary status of "Endangered" [EN B1ab(iii)+2ab(iii)] based on the *IUCN Red*

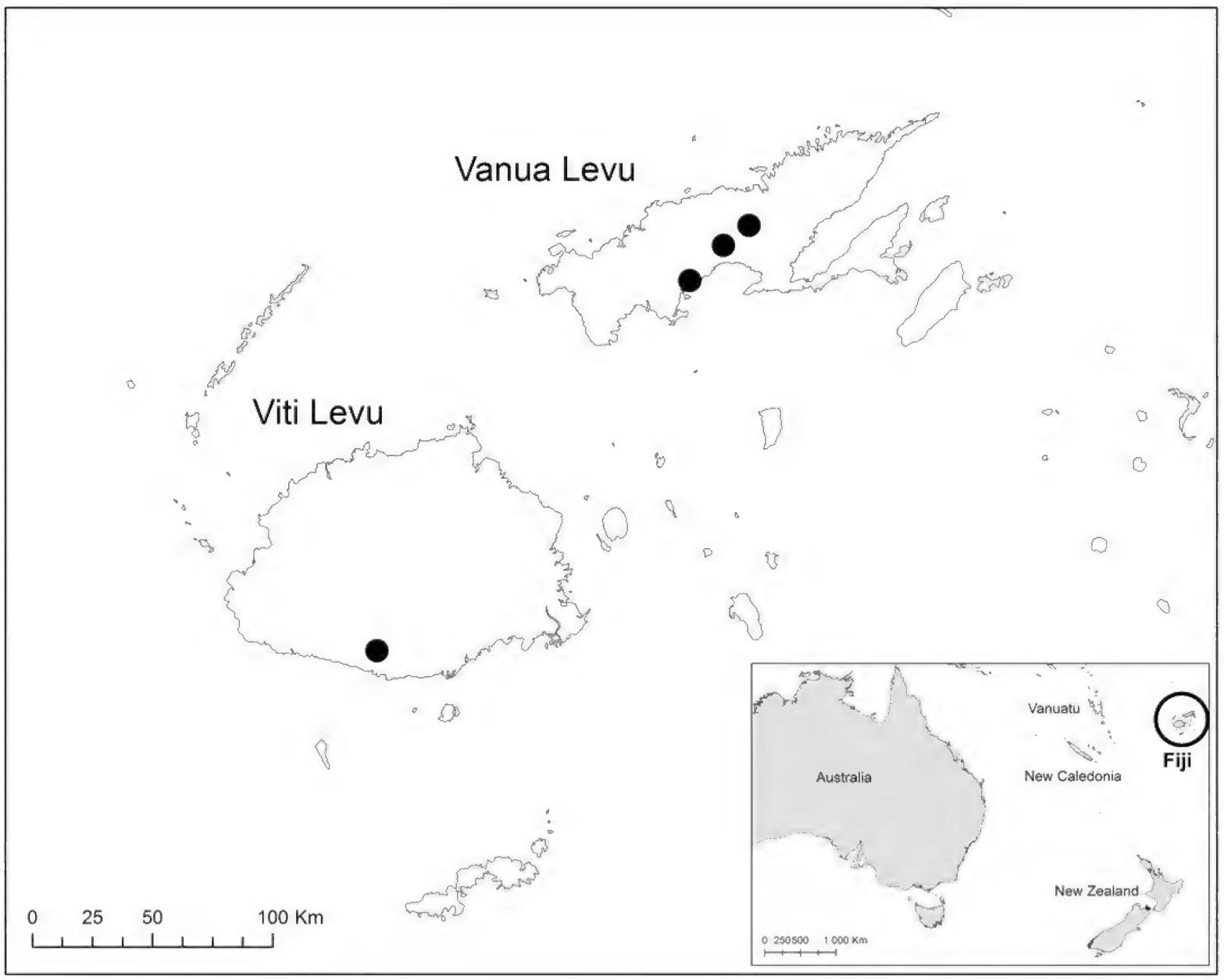

Figure 4. Species distribution map of *Alectryon vitiensis* Buerki, Lowry, Munzinger & Callm. in the Fiji archipelago.

List Categories and Criteria (IUCN, 2012). The new species appears to be rare and endemic to the lowland humid forests in the Fijian archipelago, which are threatened.

Paratypes. FIJI. **Vanua Levu:** Cakaudrove Prov., Wailevu Region, W of Savusavu, Waisali, 16°37′57″S, 179°12′52″E, 510 m, 3 Feb. 2011, fr., *Callmander et al. 945* (G, K, P, SUVA); Cakaudrove Prov., Wailevu-West distr., along Wailevu West coast rd., betw. Naviavia village & Keka village jct., 16°45′54 ″S, 179°05′00 ″E, 114 m, 6 Nov. 2015, fl., *Munzinger et al. 7376* (BM, G, K, L, MO, MPU [barcode] MPU310598, P, SUVA). **Viti Levu:** Serua Prov., Naboutini, 11.3 km on Nabukelevu rd., (interpreted as 18°09′31.41″S, 177°51′15.43″E), 300 m, 13 Mar. 1986, fl., *Dept. of Agriculture 19647* (G, MPU [bc] MPU310779, NOU [bc] NOU054618, SUVA).

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A New Species of *Delphinium* (Ranunculaceae) from Hubei, China

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ABSTRACT. A new species of *Delphinium* L., *D. callichromum* Q. L. Gan & X. W. Li, from Hubei, China, is described and illustrated. It belongs to *Delphinium* sect. *Anthriscifolium* W. T. Wang, which now includes two species: *D. callichromum* and *D. anthriscifolium* Hance. Both species are similar in having pinnately divided leaves, petals broadest above the midpoint, and racemose inflorescences. *Delphinium callichromum* differs from *D. anthriscifolium* in its densely long-pilose stems, racemes with more flowers, red-brown immature anthers, oblong staminode limb with a prominent midvein, and sepals with a long claw.

Key words: China, *Delphinium*, *Delphinium* section *Anthriscifolium*, Ranunculaceae.

Delphinium L. is a large genus of the Ranunculaceae, including about 350 species in the Northern Hemisphere (Wang & Warnock, 2001). The plants are cultivated for ornament because of their beautiful flowers, and 18 species are used in Chinese traditional medicine (Wang, 1979). There are about 173 species in China, which are divided into five sections: section *Aconitoides* W. T. Wang, section *Elatopsis* Huth, section *Delphinastrum* DC., section *Oligophyllon* Dimitrova, and section *Anthriscifolium* W. T. Wang. *Delphinium* sect. *Anthriscifolium* is characterized by pinnately divided leaves, petals broadest above the midpoint, and transversely lamellate seeds (Wang & Warnock, 2001) and includes only one species, *D. anthriscifolium* Hance. In a maximum likelihood analysis of the 6-marker dataset of tribe *Delphinieae* (Wang et al., 2013), *D. anthriscifolium* was sister to all other species of genus *Delphinium* sensu Jabbour and Renner (2012).

During a botanical expedition in 2007 in Zhuxi County, western Hubei Province, China, we collected some interesting specimens of section *Anthriscifolium*. We sent the specimens to Wencai Wang (PE), who initially identified them as *D. anthriscifolium* var. *majus* Pamp. However, after a few years of observation, we noticed that the plant was quite different from *D. anthriscifolium* in that it flowers earlier (March to May vs. April to August), and its aerial part wilts much earlier (May vs. September) at similar altitudes in Zhuxi, Hubei. In 2013, some individuals from the type locality were transplanted into places where *D. anthriscifolium* occurs, and we compared their morphological characteristics. We also consulted national and local floras (Wang, 1979; Fu, 2001; Wang & Warnock, 2001) and checked specimens in herbaria. Finally we determined that our species is new to science. The new species is diagnosed by its densely long-pilose stems, many-flowered racemes, oblong staminode limb as long as or longer than the sepals with a prominent midvein, red-brown immature anthers, and sepals with a long claw.

Delphinium callichromum Q. L. Gan & X. W. Li, sp. nov. TYPE: China. Hubei: Zhuxi Co., Bingying Town, Lancaiguou Village, 32°05′05.79″N, 109°55′09.93 E″, 508 m, 22 Mar. 2015, *X. W. Li 15031* (holotype, HIB!). Figure 1.

Diagnosis. *Delphinium callichromum* Q. L. Gan & X. W. Li is similar to *D. anthriscifolium* Hance but differs from it in its densely long-pilose (vs. glabrous or retrorsely puberulent) stems; racemes with 12 to 30 (vs. 1 to 10) flowers; red-brown (vs. yellow) immature anthers; oblong (vs. dolabriform or ovate) staminode limb, as long as or longer than the sepals and with a prominent midvein; and sepals with a claw almost equaling the limb (vs. a very short or absent claw).

Plants annual. Stem 12–75 cm tall, densely long-pilose, branched. Leaf blade rhombic-ovate or deltoid-ovate, 5–15 × 8–28 cm, base broadly cuneate; leaf blade pinnately 3- to 4-lobed, primary lobes ovate-lanceolate; central lobe triangular-ovate, pinnately divided nearly to midvein, distally entire or dentate, apex acuminate; ultimate lobules narrowly ovate or obovate; proximal leaves not withered. Raceme 15–30 cm, long-pilose, 12- to 30-flowered; proximal bract leaflike; distal bracts absent. Pedicels 1.5–2 cm; bracteoles 3, borne proximally on pedicel, lanceolate-linear, 3–5 mm. Sepals bluish purple, abaxially sparsely puberulent; spur subulate, 12–20 mm, base 1.5–2.2 mm diam.; upper sepal narrowly ovate or ovate-lanceolate, 6–8 mm, constricted at middle; lateral and lower sepals with broadly ovate limb, 6–8 × 5–7 mm, and claw 5–6 mm; lower 2 sepals widely divergent. Petals 2,

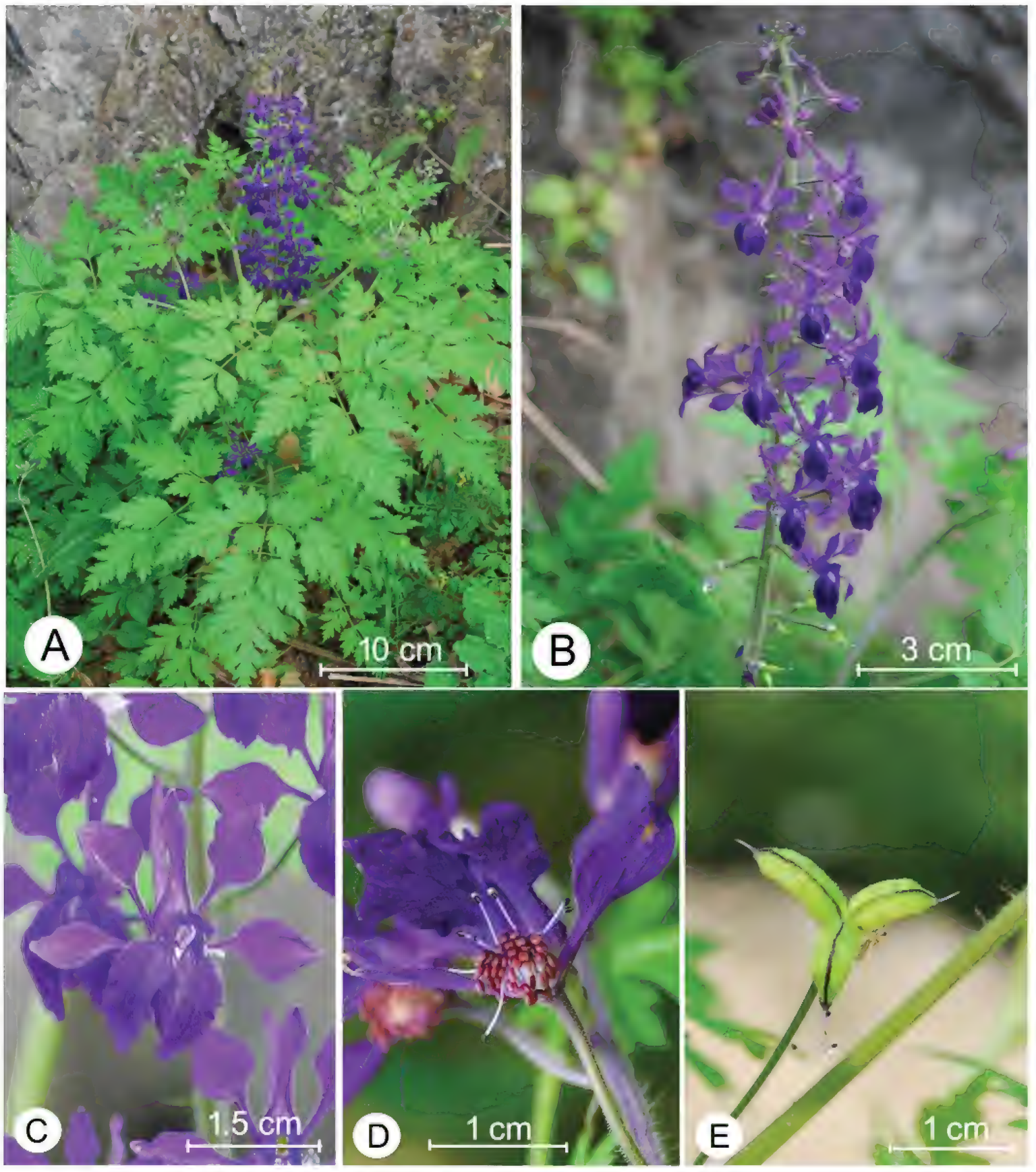

Figure 1. *Delphinium callichromum* Q. L. Gan & X. W. Li at type locality. —A. Habit of fertile plant. —B. Inflorescence. —C. Flower. —D. Anthers. —E. Fruit. A–C photos by Q. L. Gan; D, E photos by X. W. Li.

obovate, 3 × 2 mm, glabrous. Staminode limb oblong, longer than or as long as sepals, not lobed, apex obtuse, base broadly cuneate, midrib prominent. Filaments 49 to 53, linear, glabrous, 5–9 mm; anthers red-brown before maturation, dark when mature. Ovaries 3, puberulent, narrowly ovate, 4 mm, 1.1 mm diam. Capsules 1.1–1.6 cm, puberulent.

Phenology. The flowering period is from March to April and the fruiting period from April to May. The whole aerial part wilts in May.

Distribution and habitat. Three subpopulations of *Delphinium callichromum* have been found in Bingying Town, Zhuxi County, Hubei Province, China. The plants were located in Quanhe Village, Baisha Village, and Lancaigou Village. Altogether there are about 600 individuals in the population. The plants grow near shady mountain paths or on damp grassy mountain slopes, coexisting with species including *Erigeron annuus* (L.) Pers., *Pilea notata* C. H. Wright, *Debregeasia longifolia* (Burm. f.) Wedd., and *Dendranthema indicum* (L.) Des Moul.

Table 1. Morphological comparisons between *Delphinium callichromum* Q. L. Gan & X. W. Li and *D. anthriscifolium* Hance (including varieties *anthriscifolium*, *savatieri* (Franch.) Munz, and *majus* Pamp.).

	D. callichromum	*D. anthriscifolium*
Stem indumentum	densely long-pilose	glabrous or sparsely retrorsely puberulent distally
Leaves	proximal leaves not withered	proximal leaves usually withered
Raceme	12- to 30-flowered	1- to 10-flowered
Staminode limb	oblong, longer than or as long as sepals, with prominent midvein	dolabriform or ovate, shorter than sepals, without prominent midvein
Sepals	clawed, claw almost as long as limb; two lower sepals diverging at a 180° angle	without claw, or claw very short; two lower sepals narrowly divergent, angle of divergence acute
Anther color	red-brown before maturation, dark when mature	yellow before maturation, dark when mature

Etymology. The specific epithet refers to the beautiful colors of the new species.

Discussion. *Delphinium callichromum* belongs in section *Anthriscifolium* and is similar to *D. anthriscifolium* in having pinnately divided leaves, petals broadest above the midpoint, and a racemose inflorescence. *Delphinium anthriscifolium* can be subdivided into three varieties (Wang & Warnock, 2001): *D. anthriscifolium* var. *anthriscifolium*, *D. anthriscifolium* var. *majus*, and *D. anthriscifolium* var. *savatieri* (Franch.) Munz. All three varieties are common in Zhuxi, Hubei, China; however, *D. callichromum* is not found in the same habitats as *D. anthriscifolium*. Compared with populations of *D. anthriscifolium* from nearby areas, *D. callichromum* is easily distinguished from *D. anthriscifolium* by its pilose stem indument, racemes with more numerous flowers, long-clawed sepals, and oblong staminode limbs longer than the sepals, as well as other minor characters. The morphological differences between the two species are summarized in Table 1. Based on our observation and former studies (Wang, 1979; Wang & Warnock, 2001), a key to the taxa of *Delphinium* with pinnate leaves in China is as follows.

Key to the Taxa of *Delphinium* sect. *Anthriscifolium*

1. Stem densely pilose; raceme with 12 to 30 flowers; staminode limb oblong, longer than or as long as sepals, with prominent midvein; aerial part wilting in May. . . . . *D. callichromum* Q. L. Gan & X. W. Li
1′. Stem glabrous or sparsely retrorsely pubescent; raceme with 1 to 10 flowers; staminode limb dolabriform or ovate, shorter than sepals, without prominent midvein; aerial part wilting in September or October.
   2. Spur 1.7–2.2 cm with base 3–4 mm diam., lateral and lower sepals 1.2–1.6 cm. . . . *D. anthriscifolium* var. *majus* Pamp.
   2′. Spur 0.5–1.5 cm with base 1.5–2 mm diam., lateral and lower sepals 0.6–1.1 cm.
      3. Staminode limb dolabriform, 2-parted . . . . . *D. anthriscifolium* var. *anthriscifolium*
      3′. Staminode limb ovate, 2-lobed. . . . . *D. anthriscifolium* var. *savatieri* (Franch.) Munz

Paratypes. CHINA. **Hubei:** Zhuxi Co., Bingying Town, Baisha Village, 32°04′29.73″N, 109°54′24.53″E, 416 m, 31 Mar. 2007, *Q. L. Gan 1908-1* (HIB), *1908-2* (HIB), *1908-3* (HIB), *1908-4* (HIB); Lancaigou Village, 32°05′05.79″N, 109°55′09.93 E″, 508 m, 22 Mar. 2015, *X. W. Li 15032* (HIB); Quanhe Village, 32°02′43.34″N, 109°52′34.94 E″, 413 m, 22 Mar. 2015, *X. W. Li 15033* (HIB).

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Senecio subser. *Polyphylli*, a New Name for *Senecio* subsect. *Radiati* (Asteraceae, Senecioneae) from Southern South America

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Abstract. *Senecio* L. subsect. *Radiati* Cabrera, an illegitimate name, is replaced with the name *Senecio* subser. *Polyphylli* Giuliano, M. P. Hernández & S. E. Freire, nom. nov.; the epithet of the replacement name refers to the type species of this subsection, *S. polyphyllus* Kunze ex DC. The epithet *Radiati* was previously published by Bentham to designate a series of *Senecio*.

Resumen. Se propone aquí el reemplazo del nombre ilegítimo *Senecio* L. subsect. *Radiati* Cabrera por *Senecio* subser. *Polyphylli* Giuliano, M. P. Hernández & S. E. Freire, nom. nov.; el epíteto del nombre de reemplazo alude a la especie tipo de esta subsección, *S. polyphyllus* Kunze ex DC. El epíteto *Radiati* había sido utilizado previamente por Bentham para designar una serie de *Senecio*.

Key words: Asteraceae, Compositae, homonym, replacement name, *Senecio*, series *Chilenses*, subseries *Radiati*.

The epithet *Radiati* was first used for an infrageneric taxon in *Senecio* L. by Bentham (1867) for 20 species from Australia; the name was published at the rank of series. Independently, Cabrera (1949) used the same epithet for a subsection of *Senecio* sect. *Suffrutecius* (currently *Senecio* ser. *Chilenses* DC. ex M. G. López, A. F. Wulff & Xifreda) that included Andean and Patagonian species. Later, Cabrera et al. (1999) reduced *Senecio* subsect. *Radiati* Cabrera to the rank of subseries.

Although the epithet *Radiati* was published at different infrageneric ranks within *Senecio* by Bentham and Cabrera, the two epithets are homonyms, according to the International Code of Nomenclature (ICN; McNeill et al., 2012: Art. 53.4 and Art. 21, Note 1). Therefore, the names *Senecio* subsect. *Radiati* Cabrera and *Senecio* subser. *Radiati* Cabrera & S. E. Freire (typified by *S. polyphyllus* Kunze ex DC.) are illegitimate. Hence, we propose here the following replacement name for this group, which we recognize as a subseries.

Senecio subser. **Polyphylli** Giuliano, M. P. Hernández & S. E. Freire, nom. nov. Replaced name: *Senecio* subsect. *Radiati* Cabrera, Lilloa 15: 174. 1949, nom. illeg., non *Senecio* ser. *Radiati* Benth., Flora Australiensis 3: 663. 1867. *Senecio* subser. *Radiati* Cabrera & S. E. Freire, Fl. Fanerog. Argent. 62: 47. 1999, nom. illeg. TYPE: *Senecio polyphyllus* Kunze ex DC.

Senecio subser. *Polyphylli* comprises 23 species with principally Andean distribution in Chile and Argentina; only one species (*S. potosianus* Klatt) reaches western Bolivia (Cabrera, 1949; Freire et al., 2014; Hernández, 2016). They are mainly characterized by their subshrubby habit and radiate capitula, which are solitary or in corymbs of few capitula.

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A New Name and New Status in *Vriesea* (Bromeliaceae) from Brazil

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ABSTRACT. The infraspecific taxon *Vriesea gradata* Mez var. *bicolor* E. Pereira & I. A. Penna is elevated to the rank of species and given the new name *V. fluviatilis* Kessous & A. F. Costa, and the taxonomy and geographical distribution of this species are discussed.

Key words: Atlantic Rainforest, Bromeliaceae, Tillandsioideae, *Vriesea*.

Vriesea Lindl. is one of the largest genera of Bromeliaceae, with more than 210 species occurring in Argentina, Bolivia, Peru, Venezuela, the Caribbean, and Brazil, with 81% of these in the Atlantic Rainforest domain (BFG, 2015; Barfuss et al., 2016). It was traditionally divided into two sections: *Vriesea* sect. *Vriesea*, with red or yellow floral bracts, oblong petals, exserted stamens, and flowers with diurnal anthesis, and *Vriesea* sect. *Xiphion* (É. Morren) É. Morren, with brown floral bracts, obovate petals, included stamens, and flowers with nocturnal anthesis (Smith & Downs, 1977; see Barfuss et al., 2016 for comments on the sections). The genus has rupicolous, terrestrial, and mainly epiphytic habits (Benzing, 2000; Costa et al., 2014). The aim of this paper is to elevate *V. gradata* Mez var. *bicolor* E. Pereira & I. A. Penna to the rank of species and propose a new name.

Vriesea fluviatilis Kessous & A. F. Costa, nom. nov., stat. nov. Replaced name: *Vriesea gradata* Mez var. *bicolor* E. Pereira & I. A. Penna, Bradea 4(19): 137. 1985. TYPE: Brazil. Rio de Janeiro: Conceição de Macabú, 17 July 1984, *R. Menescal s.n.* (holotype, HB-77773!). Figure 1.

Plants spreading by rhizomes, epiphytic, (55–)90 cm. Leaves ca. 20, forming a funnel-shaped rosette; leaf sheath obovate, 6–11 × 4.5–6.5 cm, indument densely lepidote on both sides, green-whitish; leaf blade linear, 27–41 × 3–4 cm, indument lepidote on both sides, densely so on abaxial face; apex obtuse to acute, with standing peaked projection, green. Inflorescences of 20 to 40 flowers, (30–)50–80 cm, simple, erect, flowers congested, spaced 0.5 cm apart, distichous, suberect; peduncle 23–30 cm, ca. 6 mm diam., glabrous, green-whitish; peduncle bracts erect, imbricate, oblong or ovate, 5–8.2 × 2–3.5 cm, indument lepidote on both faces, greenish; rachis straight to geniculate, not apparent during flowering, 11–24(–45) cm, ca. 5 mm diam., glabrous, pale red; floral bracts ovate, with deciduous apices, 4–4.5 × 3.4 cm, involute, longer than sepals, sparsely lepidote, red-orange with green or yellow apices. Flowers with diurnal anthesis, ca. 6.5 cm; pedicel robust, ca. 5.5 × 3.8 mm; sepals with acute apices, 3.3–3.5 × 1 cm, yellow; corolla tubular, asymmetrical with 1 higher and 2 lower petals; petals lanceolate or linear with rounded, curved apex, 4.2–4.3 × 0.85 cm, connate for 4.5 mm, yellow with green-tipped apex; petal appendages ca. 9 (5.5 mm free) × 3 mm, obtuse with rounded apices; stamens positioned at the top of the corolla, filaments complanate at the base and adnate to the base of the petals, 40–42 × 0.7 mm, yellow; anthers 5.5 × 1 mm, yellow, exserted, dorsifixed; stigmas of convolute-blade type, green. Fruits suberect, ca. 4.5 cm, seeds with apical appendage, ca. 2 cm.

Distribution and habitat. *Vriesea fluviatilis* is endemic to the Atlantic Rainforest in the state of Rio de Janeiro. Present populations known have abundant individuals in restricted geographical areas in the northern Serra do Mar, the region of the Parque Estadual do Desengano (close to the type), and Sana (Macaé).

Etymology. The epithet *fluviatilis* is chosen because this species is always found close to watercourses.

Notes. Pereira and Penna (1985) described *Vriesea gradata* var. *bicolor*, distinguishing it from the typical variety mainly by the floral bracts, which were red with yellow apices (vs. entirely dull red) and drying posteriorly. However, several morphological characteristics were observed in this taxon that differentiate it from *V. gradata* var. *gradata*, including a plant height of ca. 90 cm (vs. ca. 60 cm); floral bracts longer than the sepals (vs. shorter) and with deciduous apices at fruiting (vs. persistent); sepals elliptical, ca. 3.5 cm long (vs. oblong, ca. 4.5 cm long); and petals with green-tipped apices

Figure 1. *Vriesea fluviatilis* Kessous & A. F. Costa. —A. Habitat of *V. fluviatilis*, close to Rio Sana. —B. Inflorescence. —C. Floral bracts with deciduous apex and flower. A, B photos by Igor M. Kessous; C photo by Andrea F. Costa.

(vs. entirely yellow). These differences are sufficient to merit recognition at the species level. The name *V. bicolor* L. B. Sm. had been published previously [≡ *Werauhia bicolor* (L. B. Sm.) J. R. Grant], so the epithet "*bicolor*" cannot be used for this taxon at the species level. Thus, the new name *V. fluviatilis* is published here in accordance with the International Code of Nomenclature (McNeill et al., 2012; Art. 6.11).

Specimens examined. BRAZIL. **Rio de Janeiro:** Macaé, mata pluvial, 24 Sep. 1997, fl., *Costa 700* (R); Distr. do Sana, mata ao redor da Cachoeira da Mãe, 22 May 2014, fr., *Kessous & Couto 112* (R); Distr. do Sana, Sítio Bambu, Poço da Gruta, 8 Mar. 2017, fl., *Kessous & Tartaglia 264* (R); Santa Maria Madalena, Parque Estadual do Desengano, Pedra do Desengano, Floresta Pluvial Tropical costeira de altitude da base da Pedra do Desengano, 1200 m, 17 Dec. 1986, *Martinelli et al. 12000* (RB); Parque Estadual do Desengano, Serra da Forquilha, Dec. 1991, fl., *Costa et al. 501* (RB); Parque Estadual do Desengano, Serra da Rifa, 20 Jan. 1957, fl., *Mello-Filho 1205* (R), 21 May 2014, fr., *Kessous & Couto 109* (R).

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Validation of the Name *Paraphlomis hispida* (Lamiaceae)

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ABSTRACT. The name *Paraphlomis hispida* (Lamiaceae), proposed by C. Y. Wu, was originally described from Yunnan, China, but was not validly published because the author simultaneously cited three gatherings without indicating the holotype in the protologue. The name is validated here by designating *C. W. Wang 83872* as the holotype of *P. hispida* C. Y. Wu.

Key words: China, Lamiaceae, *Paraphlomis*.

During compilation of the type specimens in the Chinese National Herbarium (PE), Institute of Botany, Chinese Academy of Sciences, we discovered that the name *Paraphlomis hispida* C. Y. Wu (Lamiaceae) was published simultaneously citing three gatherings (*C. W. Wang 83872* and *85447* and *K. M. Feng 13539*) while without indicating the type (Wu, 1959). According to Article 40.1 and 40.2 of the *International Code of Nomenclature for Algae, Fungi, and Plants (Melbourne Code)* (McNeill et al., 2012), this name was not validly published. Without commenting on the validity of publication, Wu and Li (1977) and Li and Hedge (1994) later utilized the name in the *Flora Reipublicae Popularis Sinicae* and *Flora of China*, respectively. We examined these three gatherings at PE (the author C. Y. Wu's workplace) and other specimens in the genus *Paraphlomis* (Prain) Prain at HITBC, IBK, and KUN, and herein validly publish the name by designating *C. W. Wang 83872* as the holotype of *P. hispida*. The current paper validates the name by reference to the Latin description in the original publication (Wu, 1959: 39). The correct authorial attribution for the name is C. Y. Wu because the name and the validating description for this species are herein explicitly ascribed to him (cf. Art. 46.2; McNeill et al., 2012).

Paraphlomis hispida C. Y. Wu, sp. nov. "*Paraphlomis hispida* C. Y. Wu" in Acta Phytotax. Sin. 8(1): 39, pl. 4, figs. 14–18. 1959, nom. inval. TYPE: China. Yunnan: Malipo, Huangjinyin, in dense woods, 1300 m, 15 Jan. 1940, *C. W. Wang 83872* (holotype, PE [barcode] 00834761!; isotype, KUN Herb. No. 0484562!).

Discussion. *C. W. Wang 83872* (PE) is chosen as the holotype because it is better preserved and more complete (with complete branches, leaves, and flowers), agrees with the protologue, and has both a basic label and a new species determination label signed by C. Y. Wu on 26 July 1957.

Paraphlomis hispida is morphologically most similar to *P. javanica* (Blume) Prain, sharing features such as a retrorsely strigose stem, slender petiole, and elliptic, abaxially strigose leaf blade. *Paraphlomis hispida* differs in its height of 40–60 cm, bristly calyx, and lanceolate bracteoles (vs. height of 50–150 cm, not bristly calyx, and subulate bracteoles in *P. javanica*).

Habitat and distribution. *Paraphlomis hispida* is known from southwestern China (southeastern Yunnan and southwestern Guangxi) and northern Vietnam, growing in dense forests, bamboo forests or thickets in mountains, or limestone hills at altitudes from 260 to 1500 m.

Other specimens examined. CHINA. **Guangxi:** Huanjiang, Mulung, mountains, 420 m, 7 May 1997, *P. J. Cribb et al. ASBK 430* (PE); Lingyun, streamsides, 6 Aug. 1939, *L. Q. Chen 92449* (2 sheets, IBK); Longzhou, Daqingshan, in evergreen broad-leaved forests, 21 July 2011, *W. B. Xu et al. LZ 1238* (IBK); Longzhou, Jinlong, limestone hills, in broad-leaved forests, 18 July 2011, *Y. S. Huang et al. LZ 1110* (IBK). **Yunnan:** Malipo, Dongting, in open thickets on rook, 1200–1500 m, 22 Nov. 1947, *K. M. Feng 13539* (KUN, PE); Xichou, Fadou, in forests, 1300 m, 8 Dec. 1939, *C. W. Wang 85447* (KUN, PE), 5 June 1964, *Anonymous s.n.* (HITBC); Wutaishan, under bamboo forest, 1300 m, 10 July 1996, *S. K. Wu et al. 3822* (KUN). VIETNAM. **Lao Cai:** limestone hills, in forests, 260–300 m, 22 Dec. 1964, *Sino-Vietnam Exped. 704* (KUN).

Acknowledgments. Thanks are due to the curators of HITBC, IBK, KUN, and PE for permission to examine specimens. This work was supported by the National Natural Science Foundation of China (grant no. 31370657) and the Key Project for the Development of State Facilities and Information Infrastructure for

Science and Technology (National Specimen Information Infrastructure, 2005DKA21401). We also thank the reviewers for revising our manuscript.

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Typhonium thatsonense (Araceae), a New Species from Vietnam

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ABSTRACT. *Typhonium thatsonense* Luu & H. T. Van (Araceae) is described and illustrated as a new species from the That Son Mountains, Mekong Delta, Vietnam. It most closely resembles *T. supraneeae* A. Galloway, Petra Schmidt & Sinhab. in its trifoliolate leaves and general appearance of the inflorescence but differs in many leaf and floral characters.

Key words: Araceae, Mekong, *Typhonium*, Vietnam.

The genus *Typhonium* Schott (Araceae) was revised by Sriboonma et al. (1994) who recorded 40 species. Since then, many *Typhonium* species have been described (e.g., Hetterscheid & Nguyen, 2001; Hetterscheid & Galloway, 2006). The genus has recently been estimated to have ca. 100 species worldwide (Boyce et al., 2012).

The number of *Typhonium* species in Vietnam was reported to be three in Gagnepain (1942), four in Pham-Hoang (1993, 2000), 13 in Nguyen and Vu (2004), and 14 in Nguyen (2005). Since then, two additional species have been reported for Vietnam, namely *T. stigmatilobatum* V. D. Nguyen and *T. vermiforme* V. D. Nguyen & Croat (Nguyen, 2008; Nguyen & Croat, 2010), while *T. horsfieldii* (Miq.) Steenis was accepted as a synonym of *Sauromatum horsfieldii* Miq. (Cusimano et al., 2010). Therefore, prior to this paper, 15 species of *Typhonium* have been known for the country.

One of our field trips to the That Son Mountains in the Mekong Delta of Vietnam in May 2014 recorded a *Typhonium* species that looks very much like *T. supraneeae* A. Galloway, Petra Schmidt & Sinhab. from Thailand (Galloway, 2012). Several individuals were then collected and planted in the authors' living collection in Ho Chi Minh City. They have annually generated consistent vegetative and reproductive characters that differ from those of *T. supraneeae*. Our careful examination of all the plants indicates that it is a new species.

Typhonium thatsonense Luu & H. T. Van, sp. nov. TYPE: Vietnam. Mekong Delta: An Giang Prov., Tinh Bien Distr., That Son Mtns., Cam Mtn., 104°59′51″E, 10°28′16″N, 250 m, 11 May 2014, *H. T. Luu, T. T. D. Ngo, L. P. Nguyen, H. T. Van & H. P. Le H. T. Van 30* (holotype, SGN!; isotypes, PHH!, SGN!). Figure 1.

Diagnosis. *Typhonium thatsonense* Luu & H. T. Van differs from *T. supraneeae* A. Galloway, Petra Schmidt & Sinhab. in having ovate leaflets, a spathe longer than the spadix and not twisted, an abaxially and adaxially dark brown and shorter spathe limb, a shorter spadix with shorter male and female segments, larger light yellow, sessile stigmas, larger light orange to yellow stamens, and mostly downward-curved and longer staminodia with acuminate, uncinate apices.

Herbs, with underground tuberous rhizome, 2–2.5 × ca. 1 cm, producing offsets and many filiform roots. Leaves solitary or up to 3. Petiole smooth, 15–20 cm, 3 mm diam., brown at base, green toward the apex. Leaf blade trifoliolate; leaflets thin, glabrous, dark green above, pale green below, apex acuminate, midrib impressed adaxially and prominent abaxially, lateral veins 5 or 6, collective veins at 4–5 mm from margin; lateral leaflets ovate, strongly asymmetrical, 7–9 × 4–5 cm, base oblique, petiolule ca. 5 mm; anterior leaflet ovate, base round, 5–6 × 3–4 cm, petiolule ca. 2 mm. Inflorescences 2; peduncle underground, white, up to 10 cm, 3 mm diam., subtended by 1 or 2 cataphyll(s); cataphyll 1 cm, light pink to white, dark brown mottled; spathe 16–18 cm; spathe base subglobose to ovoid, convolute, outside light pink to white with dark brown dots and pink longitudinal veins, inside pink to pale brown, 8 mm, 10 mm diam., separated from the limb by a constriction; spathe limb dark brown on both sides, linear-lanceolate, 15–17 cm, 3 mm diam. at base; spadix shorter than spathe, 12–14 cm; female part broadly conical, 2–2.5 mm high, 4–5 mm diam., with 4 rows of crowded pistils; ovary obovoid, truncate, 1 mm high, 0.6 mm diam. near top, translucent white, 1-locular,

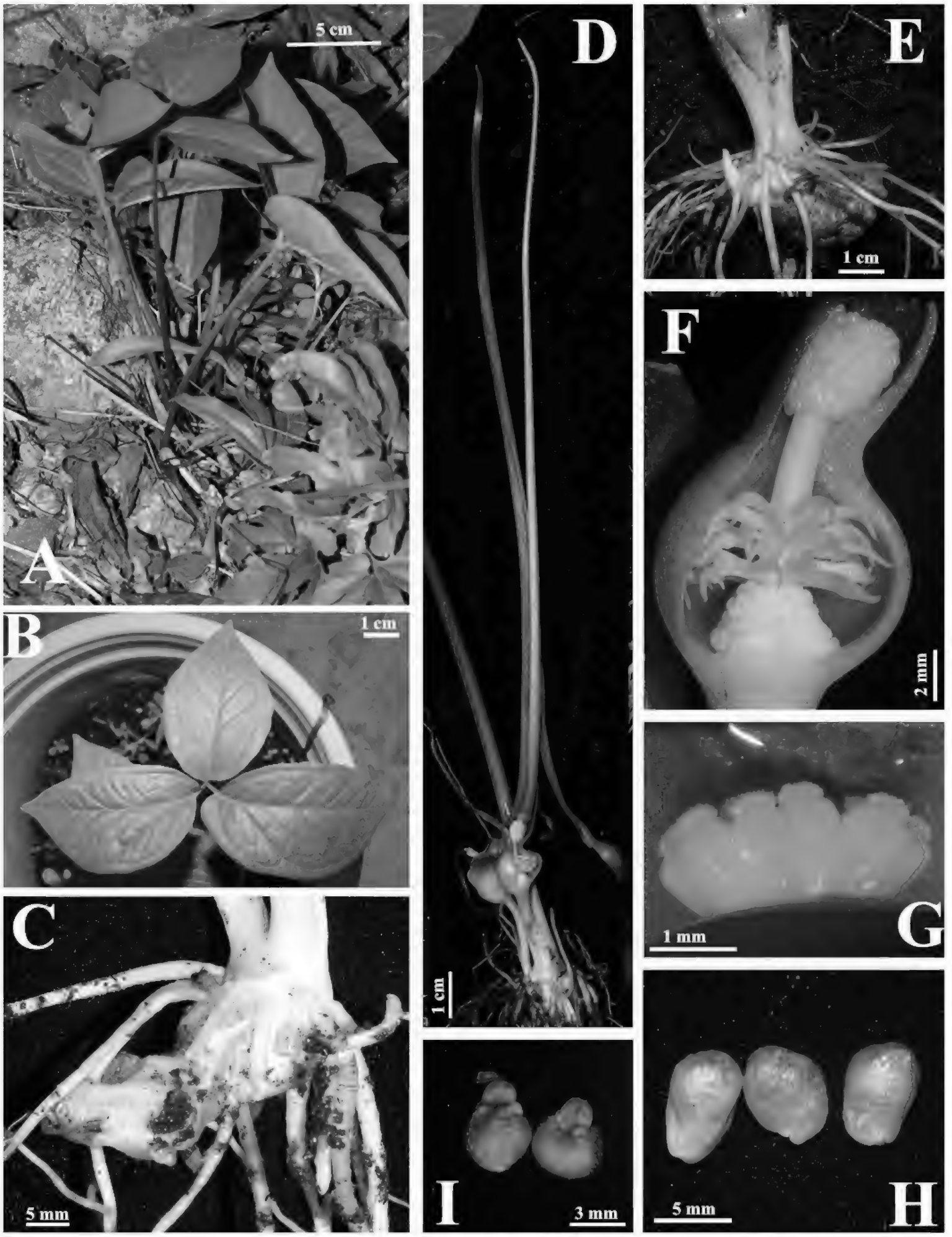

Figure 1. *Typhonium thatsonense* Luu & H. T. Van. —A. The species in habitat. —B. Leaf blade, top view. —C. Tuberous rhizome. —D. Spathe and spadix. —E. Offsets and cataphyll. —F. Female, sterile, and male parts. —G. Ovaries. —H. Fruits. —I. Seeds. A, F–I photos by H. T. Luu; B–E photos by H. T. Van.

with 1 basal ovule; style absent; stigma disciform, 0.3 mm high, 0.5 mm diam., light yellow, papillate; sterile part above female part, ca. 8 mm, naked; staminodes subulate with acuminate apices, perpendicular to the spadix axis, uncinate, apices mostly curved downward, ca. 4.5–5 mm, basally white, apically bright yellow, apex acuminate, surface verruculose; male part obovoid, 4–4.5 mm high, 4.5–5 mm diam.; stamens densely arranged, light orange when young, yellow at anthesis, ca. 1 mm long, 1 mm diam., thecae

Table 1. Morphological differences between *Typhonium supraneeae* A. Galloway, Petra Schmidt & Sinhab. and *T. thatsonense* Luu & H. T. Van.

	T. supraneeae	*T. thatsonense*
Leaves	solitary	solitary to 3
Petiole	dark gray to reddish brown	basally brown and apically green
Leaflets	elliptic	ovate
Inflorescences	solitary	2
Peduncle	pale green, dark gray to reddish brown, mottled	white
Spathe	28 cm, shorter than spadix	16–18 cm, longer than spadix
Spathe base	ellipical-ovoid	subglobose to ovoid
Spathe limb	lanceolate, 27 cm, 1 cm diam., sometimes twisted and folded, outside and inside dirty cream basally and brownish apically	linear-lanceolate, 15–17 cm, 3 mm diam. at base, not twisted, dark brown on both sides
Spadix	31 cm	12–14 cm
Female part	conical, 4 mm high	broadly conical, 2–2.5 mm high
Stigma	0.1 mm high, 0.3 mm diam., reddish	0.3 mm high, 0.5 mm diam., light yellow
Style	0.3 × 0.3 mm, pale pink	absent
Ovaries	lower half white, upper half pale pink	white
Male part	cylindric, 8 mm high	obovoid, 4–4.5 mm high
Stamens	pale cream, ca. 0.3 mm, 0.2–0.3 mm diam.	light orange when young, yellow at maturity, ca. 1 mm, 1 mm diam.
Staminodes	with obtuse apex, straight or ± uncinate, 0.5–2 mm, pink to pale pink	with acuminate apex, uncinate, mostly curved downward, 4.5–5 mm, basally white, apically bright yellow
Habitat	shaded areas among crevices of limestone boulders	open and semi-shaded soils among crevices of granite boulders

opening apically by oval pore; appendix shortly stipitate, filiform, tapering to apex, 10–13 cm, 3 mm diam. at base, smooth, basally brown, apically dark yellow. Infructescence globose, surrounded by persistent spathe base; fruits obovoid, 1-seeded, 5–6 mm high, 3.5–4 mm diam., translucent white, apically brown-stained; seeds round to subglobose, bright brown, 3 mm diam.

Distribution and habitat. *Typhonium thatsonense* was found in open and semi-shaded soils among granite rocks; it is only known from the type location.

Etymology. The new species is named after its type location, the That Son Mountains.

Discussion. *Typhonium thatsonense* closely resembles *T. supraneeae*, which was recently described from Thailand (Galloway, 2012). Both have perfectly trifoliolate leaves, unlike any other species in the genus. They also share several other characters in common, including a tuberous rhizome, a spathe constricted between tube and limb, and a convolute spathe base. However, they have a number of differences, as summarized in Table 1.

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Onopordum podlechii, a New Name for *O. arabicum* Podlech (Asteraceae, Cardueae)

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ABSTRACT. The name *Onopordum arabicum* Podlech is illegitimate because there exists an earlier homonym. A new name, *O. podlechii* Negaresh, is proposed for *O. arabicum* Podlech.

Key words: Asteraceae, Cardueae, *Onopordum*.

The name *Onopordum arabicum* L. was validly published in 1753. Later, Podlech (1982) published a species from Yemen under the same name. According to the International Code of Nomenclature (Art. 53.1; McNeill et al., 2012), *O. arabicum* Podlech is an illegitimate later homonym. The replacement name *O. podlechii* Negaresh is therefore published here. The specific epithet is given in honor of Prof. Dr. Dieter Podlech, author of the replaced name, who has worked extensively on Old World *Astragalus* L. and other difficult and species-rich genera of vascular plants.

Onopordum podlechii Negaresh, nom. nov. Replaced name: *Onopordum arabicum* Podlech, Mitt. Bot. Staatssamml. München 18: 432. 1982, nom. illeg., non *O. arabicum* L., Sp. Pl. 2: 827. 1753, nec *O. arabicum* Bové ex DC., Prodr. 6: 618. 1838. TYPE: Yemen. Inner jemenitisches Hochland, 29 km N Sana'a an der Straße nach Alram, S'Hänge W des Djebel Djerban, 2550 m, 3 Oct. 1981, *D. Podlech 36244* (holotype, M!; isotype, Herb. Podlech not seen). Figure 1.

Acknowledgments. I thank Dr. Hans-Joachim Esser (M) for the digitized picture of the holotype of *Onopordum arabicum* Podlech.

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McNeill, J., F. R. Barrie, W. R. Buck, V. Demoulin, W. Greuter, D. L. Hawksworth, P. S. Herendeen, et al. (editors). 2012. International Code of Nomenclature for Algae, Fungi, and Plants (Melbourne Code). Regnum Veg. 154.

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Figure 1. Holotype of *Onopordum podlechii* Negaresh deposited in M (*D. Podlech 36244*).

Three Previously Undescribed Species of *Quercus* (Fagaceae) from Mesoamerica and the Designation of a Lectotype for *Q. acutifolia*

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Abstract. Three previously unrecognized species of *Quercus* L. from Mexico and Central America are named and described here: *Q. breedloveana* Nixon & Barrie, *Q. sarahmariae* Nixon & Barrie, and *Q. melissae* Nixon & Barrie. Additionally, a lectotype is designated for the name *Q. acutifolia* Née, thereby stabilizing its application.

Key words: Fagaceae, Mesoamerica, *Quercus*.

Central American oaks have been taxonomically problematic because, with the exception of Trelease (1924) and Muller (1942), there has been no comprehensive oak treatment that covers the entire region. Other issues arise because of the great variability within some species, and the well-known propensity for hybridization among closely related species of oak. Trelease and Muller had very narrow species concepts, which resulted in the recognition of many names that we (and others) have now placed in synonymy. However, some species that we now believe to be amply distinct have also been subsumed, as evidenced by recent annotations in herbaria, which have also been followed in some recent treatments that cover portions of Mesoamerica (e.g., Breedlove, 1986, 2001; Berendsohn et al., 2009).

An additional factor complicating the taxonomy of the Central American species is the lack of a comprehensive treatment of Mexican species. Some widespread Mexican species extend southward into adjacent countries (e.g., *Quercus crassifolia* Bonpl.), and at least one is even more widespread, extending from eastern Mexico to Panama (*Q. cortesii* Liebm.). In other cases, however, names based on Mexican types have been misapplied across Central America. A good example of such a name is *Q. salicifolia* Née, which is found in herbaria applied to a wide variety of species with narrow leaves from as far south as Panama that do not actually resemble the type from western Mexico.

Here we describe three new species: two members of the red oak group and one member of the white oak group. A comprehensive key to the Mesoamerican species will be published in the forthcoming Volume 2 of *Flora Mesoamericana* (Nixon & Barrie, ined.). An electronic key to Mesoamerican oaks is under development and will be made available at <http://plantsystematics.org>.

Quercus sect. *Lobatae*

1. Quercus breedloveana Nixon & Barrie, sp. nov. TYPE: Mexico. Guerrero: Mun. Leonardo Bravo, 2 km al S de Yerba Santa, carretera Filo de Caballo-Puerto del Gallo, Bosque mesófilo de montaña, 1890 m, 17 July 1982, *J. L. Contreras 1207* (holotype, CAS!; isotypes, CAS!, FCME not seen). Figure 1.

Diagnosis. This species differs from *Quercus paxtalensis* C. H. Mull. in having highly symmetric elliptic leaves, consistently cuneate to rounded-attenuate leaf bases, and broadly ovoid to depressed globose, vs. cylindric-ovoid, nuts.

Trees to 20 m or more. Twigs 1–2 mm diam., terete, red-purple or gray, glabrous, lenticels usually obscure. Stipules caducous. Buds 2–3 mm, globose or ovoid, apex bluntly acute, brown, glabrous. Leaf blades 9–21 × 2.4–6 cm, narrowly elliptic or lance-elliptic, ca. 3 to 4 times as long as wide; veins 6 to 14 per side, straight and ascending, uniformly spaced, all but the lowermost terminating in a bristle; upper surface green, glabrous, somewhat shiny, veins planar; lower surface pale green, glabrous rarely with a few hairs in the vein axils, veins convex; base cuneate or narrowly cuneate, or narrowly rounded-attenuate, sometimes oblique; margins undulate, with or without triangular teeth subtending the setae, setae 12 to 26, 1–4 mm; apex acuminate to caudate acuminate, tip somewhat falcate, usually with a bristle, 1–5 mm; petioles 6–39 mm, red basally, glabrous. Fruit annual, usually solitary at maturity; cup 17–21 × 10–12 mm, turbinate; nut 14–17 × 13–15 mm, broadly ovoid or depressed-globose, glabrous or scarcely puberulent, included about 1/3 of length in cupule.

Figure 1. *Quercus breedloveana* Nixon & Barrie (holotype, *J. L. Contreras 1207*, CAS).

Habitat. *Quercus breedloveana* occurs in cloud forests, often with *Liquidambar* L., at 1100–1800 m.

Etymology. *Quercus breedloveana* is named in honor of the late Dennis Breedlove, of the California Academy of Sciences, who collected extensively in Chiapas during his career and had a great interest in the taxonomy of *Quercus* L. Without the abundant material collected by Breedlove both in Chiapas and elsewhere in Mexico, our understanding of the taxonomy of tropical American *Quercus* would be far less complete.

Discussion. *Quercus breedloveana* is part of a complex of red oaks found in eastern, western, and southern Mexico and extending into Central America. These species have a tendency to produce long setae on the marginal teeth of the leaf blade. Within the complex, some species have annual fruit (including *Q. breedloveana*), while others have biennial fruit. This character can usually be seen in the field by examining a range of twigs. If maturing fruit is found on current season twigs, fruition is annual. If two classes of flowers/fruits are found, with maturing fruits on (often bare) twigs of the

previous season, with tiny undeveloped female flowers/cups on new growth, fruition is biennial.

Although *Quercus breedloveana* superficially resembles both *Q. xalapensis* Bonpl. and *Q. skinneri* Benth. in leaf characters, the acorns of those species are clearly biennial, and much larger than those of *Q. breedloveana*. Within Central America, two species with annual fruition might be confused with *Q. breedloveana*: *Q. paxtalensis* C. H. Mull. and *Q. cortesii*. *Quercus paxtalensis* differs in having more asymmetric leaves, typically with a rounded to truncate base, and often longer petioles. In contrast, the leaves of *Q. breedloveana* are strikingly symmetric, consistently elliptic, with usually shorter petioles and acute bases. *Quercus breedloveana* differs from *Q. cortesii* in having longer petioles and more teeth on the leaf margins, which are distributed around the entire margin as opposed to teeth that are restricted to the distal third or half in *Q. cortesii*.

Paratype. MEXICO. **Chiapas:** Mun. Villa Corzo, steep slopes at the E base of Cerros Tres Picos near Cerro Bola along a logging rd. SW of Colonia Agronomos Mexicanos, 16°12′38″N, 95°35′46″W, 1500–1800 m, 4 May 1972, *D. E. Breedlove 24954* (CAS).

2. Quercus sarahmariae Nixon & Barrie, sp. nov. TYPE: Costa Rica. Puntarenas: P.I. La Amistad, foothills of the Cordillera de Talamanca, Sito Coto Brus, ca. 8.59°N, 82.46°W, 1800–1900 m, montane oak forest, 3 Sep. 1983, *G. Davidse 24503* (holotype, MO!; isotype, CR not seen). Figure 2.

Diagnosis. This species differs from *Quercus rapurahuensis* Pittier ex Seemen in typically having at least some leaves with 1 to 5 teeth along the margin on the distal quarter, and in its larger nuts, 21–36 × 23–25 mm versus 15–20 × 16–20 mm.

Large trees to 45 m or more. Twigs 2–4 mm diam., fluted or terete, dark purplish black, glabrous; lenticels obscure to prominent, white. Stipules caducous. Buds 2–5 mm, ovoid, apex rounded to bluntly acute, brown, glabrous. Leaf blades 6–22 × 2.5–8.5 cm, narrowly elliptic to elliptic, ca. 2 to 4 times as long as wide; veins 12 to 15 per side, ascending, straight or arcuate, bifurcating distally; upper surface dull green, glabrous, veins planar; lower surface green-bronze, veins prominent, glabrate or pubescent along the midvein and secondary veins, more so near the base; base cuneate; margin entire, plane or crisped, the occasional leaf (usually some present on each tree) with 1 to 5 teeth along the distal 1/4, if present the teeth triangular and with or without a bristle, 1–4 mm; apex acuminate, usually with a bristle, 0–2 mm; petiole 7–22 mm, dark basally, glabrate or with a few hairs. Fruit annual, usually solitary at maturity, with a few aborted fruits often present; cup 6–10 × 24–28 mm, saucer-shaped, scales imbricate, thickened basally, finely sericeous; nut 21–36 × 23–25 mm, cylindric, rarely globose or subglobose, tip rounded, base broad and flat; surface brown to dark reddish brown, puberulent, hairs easily abraded. Cotyledons free.

Habitat. *Quercus sarahmariae* occurs in wet, mostly premontane forests or cloud forests at 700–1900 m.

Etymology. *Quercus sarahmariae* is named in honor of the daughter of the senior author, Sarah Maria Nixon, who has accompanied him on several collecting trips, both for *Quercus* and other interesting plants.

Discussion. *Quercus sarahmariae* is a narrow endemic that has been variously identified under different names. In herbaria, material of this species has most often been identified as *Q. rapurahuensis* Pittier ex Seemen and, more recently, as *Q. benthamii* A. DC. It differs from both in the occasional teeth in the distal quarter of the leaf (*Q. benthamii* does not have teeth, although some specimens misidentified as *Q. benthamii* with teeth appear to be of hybrid origin), from the former in its larger leaves with typically more secondary veins, and from the latter in those characters as well as the distinctive flat-cupped and extremely large acorns. The large leaves with occasional distal teeth and very large acorns with flat, saucer-shaped cups distinguish it from all other species in the region and elsewhere.

J. & B. Lewis s.n., 13–15 Aug 1980 (F), a collection of acorns without any vegetative material from 600 m in elevation on the Osa Peninsula, appears to be *Quercus sarahmariae*. These fruits are identical in size and form to those of *Q. sarahmariae* and unlike any other species from the region. Given the elevational distribution of the species on the mainland, in relatively low premontane forest, and the geographically close proximity of the populations, the possible occurrence of *Q. sarahmariae* in the Osa is not a surprising discovery, but without leaves and/or twigs the identification must remain tentative.

Paratypes. COSTA RICA. **Limón:** Canton Talamanca, Bratsi Distr., indigenous reserve Bri Bri, 1.7 km SW of Kivut, 6.1 km SW of Alto Lari, 6 Mar. 1992, *H. Schmidt & R. Aguilar 640* (MO). **Puntarenas:** Canton de Coto Brus, Las Cruces Biological Station, on loop trail from Wilson Botanical Garden, turn right at beginning of trail, go ca. 30 m, 8 July 1998, *B. Boyle, S. J. Borgardt & K. Nixon 5311* (BH); betw. Las Alturas & Cotonsito along the Rio Coton, 31 Aug.–1 Sep. 1983, *G. Davidse 24356* (MO); foothills of the Cordillera de Talamanca, Sitio Coto Brus, 3 Sep. 1983, *G. Davidse 24527* (MO); Jardin Botanico Wilson, 1.5–2 km SW of Las Cruces de Coto Brus, 24 Jan. 1989, *M. Grayum 9294* (MO); Las Cruces Botanical Garden, 17 Mar. 1978, *G. S. Hartshorn 2158* (F); 4 mi. SW of San Vito, 14 Sep. 1966, *L. S. McIntyre 19* (BH), *20* (BH, F); hills about headwaters of the Rio de Java, above the rock quarry, ca. 4 mi. S of San Vito, 27 July 1962, *C. H. Muller 11224* (BH-CHM); 4 km N of Agua Buena, 16 July 1977, *G. L. Webster 21929* (MO). PANAMA. **Chiriqui:** beside Potrerillos, 6 May 1983, *R. J. Schmalzel 1548* (MO).

Figure 2. *Quercus sarahmariae* Nixon & Barrie (holotype, *G. Davidse 24503*, MO).

Quercus sect. *Quercus*

3. Quercus melissae Nixon & Barrie, sp. nov. TYPE: Mexico. Chiapas: 8 km S of Amatenango del Valle, oak-pine parkland, 1870 m, 13 Aug. 1958, *L. Kaplan & E. L. Davis 358* (holotype, F!). Figure 3.

Diagnosis. This species differs from *Quercus segoviensis* Liebm. in having longer petioles, 4–9 mm versus 2–4 mm, shorter peduncles, subsessile to 13 mm versus 9–60 mm, and fused, rather than free, cotyledons.

Tree to ca. 20 m. Twigs 2–3 mm diam., dark brown or gray, glabrous or sparsely scurfy-pubescent; lenticels moderately prominent. Stipules caducous, occasionally persistent. Buds 4–6 mm, ovoid to conical, apex acute, brown or tan. Leaf blades 6–17.5 × 4–9.5 cm, obovate to broadly elliptic, ca. 2 times as long as wide; veins 10 to 15 per side, ascending, straight, extending to the margin; upper surface dull gray-green, glabrous; lower surface with scattered, soft, tangled, white multiradiate hairs, with or without a few yellow, glandular hairs along the veins; base rounded or subcordate, rarely cordate-clasping; margin repand to crenate or dentate; apex broadly acute or obtuse to rounded; petioles 4–9 mm, glabrate or scurfy-pubescent. Fruits annual,

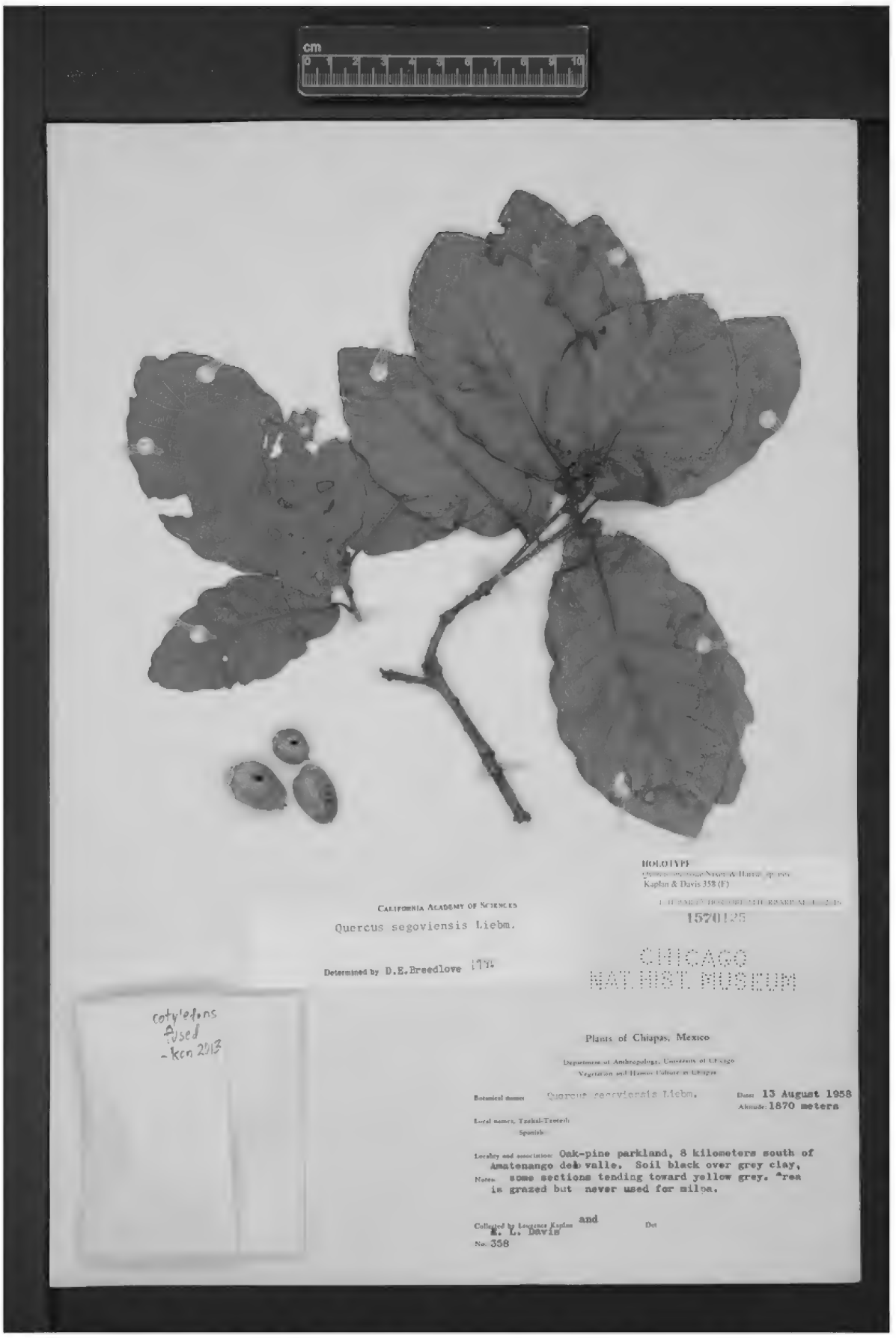

Figure 3. *Quercus melissae* Nixon & Barrie (holotype, *L. Kaplan & E. L. Davis 358*, F).

solitary or paired; peduncle subsessile to 13 mm, scurfy-pubescent; cup 7–12 × 13–22 mm, hemispheric or flattened-hemispheric, scales pubescent, gray-white, tuberculate near the base of the cup; nut 18–21 × 12–16 mm, ovoid, light to dark brown, apex puberulent. Cotyledons fused.

Habitat. *Quercus melissae* occurs in dry oak and oak-pine forests at 700–2300 m.

Etymology. *Quercus melissae* is named in honor of the daughter of the junior author, Melissa Barrie Lehmann.

Discussion. Herbarium specimens of *Quercus melissae* have been consistently identified as *Q. segoviensis* Liebm. The two species differ, however, in leaf morphology (petioles 4–9 mm vs. 2–4 mm; the upper leaf surface glabrate vs. persistently pubescent along the midvein; the lower leaf surface with scattered, tangled hairs and with glandular hairs, if present, restricted to the veins vs. either densely felty-pubescent, the hairs multiradiate and fasciculate, or glabrescent with yellow-glandular hairs scattered over the surface and multiradiate hairs on the veins), peduncle length (subsessile to 13 mm vs. 9–60 mm), and cotyledons

(fused vs. free in *Q. segoviensis* and the synonymous *Q. purulhana* Trel.). The fused cotyledons and general leaf morphology suggest that *Q. melissae* is related to the group of mostly Mexican white oaks centered around the species *Q. glaucoides* M. Martens & Galeotti. Indeed, vegetatively *Q. melissae* resembles *Q. tuberculata* Liebm., a species of northern and western Mexico, more than it does *Q. segoviensis*, differing in the persistent sparse pubescence of the lower leaf surface and the heavily pubescent peduncles and acorn cups.

Quercus liebmannii Oerst. ex Trel., an oak from Oaxaca that might be confused with this species, has free cotyledons, in contrast to the fused cotyledons of *Q. melissae*. *Quercus liebmannii* also has more regular, mostly parallel veins and a very dense, close tomentum covering the abaxial leaf surface, in contrast to the irregularly toothed leaves with looser, sparse pubescence on the abaxial leaf surface in *Q. melissae*. *Quercus liebmannii* is most similar to, and likely related to, the *Q. magnoliifolia* Née complex of western Mexico, and such a relationship is also likely for *Q. segoviensis*.

Although *Quercus melissae* is consistent in both leaf and acorn characters throughout its range in Chiapas, some material from Guatemala, where the ranges of the two species overlap, is morphologically intermediate in leaf form with *Q. segoviensis*. Given the likely divergent relationships of the two species, we interpret this as secondary intergradation.

Paratypes. GUATEMALA. **Chimaltenango:** along rd. betw. Chimaltenango & San Martin Jilotepeque, 22 Dec. 1940, *P. C. Standley 80875* (F). **Guatemala:** 10 km S of San Raimundo, 18 Jan. 1939, *P. C. Standley 62862* (F). **Huehuetenango:** near Chalchitan, 14 Jan. 1939, *P. C. Standley 62577* (F); along rd. 13 km W of Huehuetenango, near Puente de Xinaxo, 30 Dec. 1940, *P .C. Standley 81505* (F). **Jalapa:** mtns. along the rd. betw. Jalapa & San Pedro, 12 Nov. 1940, *P. C. Standley 77008* (F); mtns. along the rd. betw. Jalapa & Paraiso, 14 Nov. 1940, *P. C. Standley 77237* (F); vic. of Jalapa, 7–18 Nov. 1940, *P. C. Standley 76732* (F); Volcán Jumay, N of Jalapa, 1 Dec. 1939, *J. A. Steyermark 32423* (F). **Jutiapa:** Los Llanitos, near San Jose Acatempa, 21 Dec. 1938, *P. C. Standley 60588* (F). **Sacatepequez:** Cerro de la Cruz, above Antigua, 22 Jan. 1939, *P. C. Standley 63322* (F), *63332* (F). **Zacapa:** along Rillito del Volcan de Monos, Volcan de Monos, 10 Jan. 1942, *J. A. Steyermark 42293* (F, MO), *42306* (F), *42308* (F). MEXICO. **Chiapas:** 15 km N of Tuxtla Gutierrez on rd. to El Sumidero de Tuxtla, 18 Jan. 1965, *P. H. Raven & D. E. Breedlove 19764* (BM, DS); along Mexican Hwy. 190, 3 mi. NW of Teopisca, 28 Jan. 1965, *P. H. Raven & D. E. Breedlove 20083* (DS, F).

Lectotypification of *Quercus acutifolia*

Quercus acutifolia Née, Anales Ci. Nat. 3: 267. 1801. TYPE: Mexico. Guerrero, *Née s.n.* (lectotype, designated here, MA [bc] MA25953 as image!).

Quercus conspersa Benth., Pl. Hartw. [Bentham], 91. 1842. TYPE: Mexico. Guerrero, *Hartweg 617* (lectotype, designated by Valencia-A. et al., 2015: 291, K000512984 K!, as image; isolectotype: NY!).

[Additional synonymy listed in Valencia-A. et al. (2015).]

Discussion. The region north of Acapulco, Guerrero, Mexico, along the route to Mexico City, is home to two confusingly similar species of red oak. They may be reliably distinguished, however, by two characters: the presence of glandular hairs on the underside of the leaf and a cupule with an inrolled margin in one species versus glandular hairs absent and a patent cupule margin in the other. (A more detailed character comparison may be found in Valencia-A. et al., 2015.) Until the 1980s, the name consistently applied to the former species was *Quercus conspersa* (e.g., Trelease, 1924; Muller, 1942), with *Q. acutifolia* applied to the latter. The original material for *Q. acutifolia* is a group of specimens collected by Née in Guerrero, along the road from Acapulco to Mexico City. Seven of these are in the herbarium of the Real Jardín Botánico, Madrid (MA), another is in MPU, and several fragments taken from Madrid specimens are now in UCSB. In 1985, Dennis Breedlove visited MA, examined the specimens, and realized that they belonged to the taxon to which the name *Q. conspersa* was applied. He annotated one specimen, MA-25953, as lectotype, erroneously annotating the remaining material as either an isolectotype or a paratype. As Née did not cite specimens, his collections are defined as uncited original material and are neither syntypes nor paratypes (ICN, Art. 9; McNeill et al., 2012). Moreover, the protologue suggests that collections may have been made in several places along the route from Acapulco to Mexico City, notably in the region of Rio Mezcala; thus the specimens, which lack detailed labels indicating the precise collection site or collecting date, cannot be considered as coming from a single gathering and cannot be considered duplicates.

Breedlove never published his designation, thus, it is ineffective. He did, however, begin to annotate herbarium specimens previously identified as *Quercus conspersa* with the name *Q. acutifolia*. This had the effect of destabilizing the nomenclature of the two species, with some applying *Q. conspersa* and *Q. acutifolia* in the traditional sense of Trelease and Muller, while others took up the latter name in preference to *Q. conspersa*, using the next available name, *Q. grahamii* Benth., for what had been called *Q. acutifolia*.

A recently published paper (Valencia-A. et al., 2015) presented a detailed analysis of the two species involved and a comprehensive discussion of the type material for the relevant names. The authors designated a lectotype for *Quercus conspersa* (*Hartweg 617*, K000512984). Their attempted designation of a lectotype for *Q.*

acutifolia was ineffective, however, because it did not include the phrase "designated here" or a linguistic equivalent, as is required by the ICN (Art. 7.10; McNeill et al., 2012). We remedy the situation by designating as lectotype the same Née specimen in MA treated as such by Breedlove and Valencia-A. et al. With this designation, *Q. conspersa* falls into synonymy under *Q. acutifolia*, and *Q. grahamii* is the correct name for *Q. acutifolia* sensu Trelease and Muller.

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Four New Species of *Gentianella* (Gentianaceae, Gentianeae, Swertiinae) from Peru, with a Review of the Taxonomy of the Genus

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Abstract. Four new species of *Gentianella* Moench (Gentianaceae, Gentianeae, Swertiinae) are described from Peru. *Gentianella bussmannii* J. S. Pringle, from Amazonas Department, is characterized by nodding flowers with red corollas 20–50 mm, with the lobes about as long as or slightly shorter than the tube, and linear, apically acuminate leaves densely spaced proximally, gradually more widely spaced distally. *Gentianella empetroides* J. S. Pringle, from La Libertad Department, is similar to *G. quipuscoana* J. S. Pringle, differing in its glabrous stems, smaller leaves, and larger flowers in more compact clusters. *Gentianella nephostelium* J. S. Pringle, from Amazonas Department, is characterized by a stout stem with a persistent basal rosette of thick leaves and numerous flowers with white, campanulate corollas, proximally with purple veins, 18–25 mm, with obovate lobes ca. 3 times as long as the tube. *Gentianella yanachagensis* J. S. Pringle, from Pasco Department, is probably gynomonoecious, at least in the larger plants, and is characterized by creeping, vinelike stems, widely spaced, lanceolate leaves, and flowers with white to pale violet corollas 8–16 mm, with the lobes slightly shorter than the tube. The taxonomic history of *Gentianella*, including its distinction from related genera, exclusions based on phylogenetic studies, and infrageneric divisions that have been proposed, is reviewed.

Resumen. Se describen cuatro nuevas especies de *Gentianella* Moench (Gentianaceae, Gentianeae, Swertiinae) del Perú. *Gentianella bussmannii* J. S. Pringle, del Dpto. Amazonas, se caracteriza por las flores péndulas con las corolas rojas 20–50 mm, con los lóbulos aproximadamente tan largos como el tubo o un poco más cortos, y por las hojas lineares, acuminadas al ápice, densamente espaciadas proximalmente y gradualmente más distanciadas distalmente. *Gentianella empetroides* J. S. Pringle, del Dpto. La Libertad, se parece a *G. quipuscoana* J. S. Pringle, pero se diferencia por los tallos glabros, las hojas más pequeñas, y las flores más grandes en inflorescencias más compactas. *Gentianella nephostelium* J. S. Pringle, del Dpto. Amazonas, se caracteriza por el tallo robusto con una roseta persistente de hojas gruesas en la base, y numerosas flores campanuladas de corolas blancas venas moradas proximalmente, 18–25 mm, y con los lóbulos de las corolas obovadas, aproximadamente 3 veces tan largos como el tubo. *Gentianella yanachagensis* J. S. Pringle, del Dpto. Pasco, es probablemente ginomonóica, por lo menos en las plantas más grandes, y se se caracteriza por los tallos rastreros, las hojas lanceoladas y bien espaciadas, y por las flores con las corolas blancas a violaceas claro, 8–16 mm, con los lóbulos un poco más cortos que el tubo. Se reseña la historia taxonómica de *Gentianella*, inclusive la distinción de generós afines, las exclusiones basadas en las estudios filogenéticos, y las divisiones infragenéricas que han se puesto.

Key words: Gentianaceae, Gentianeae, *Gentianella*, Neotropics, Peru.

The genus *Gentianella* Moench (nom. cons.; Gentianaceae, Gentianeae, Swertiinae) consists of ca. 300 species, which are widely distributed in temperate, arctic, and alpine regions in the Northern Hemisphere, as well as at high elevations in Australia and New Zealand and in South America. A gap of ca. 2800 km separates the northernmost populations of any species of *Gentianella* in South America from the southernmost of those in Mexico.

The greatest diversity in *Gentianella*, both in number of species and in morphology, is in the Andes of South America, where ca. 200 species are native. Hagen and Kadereit (2001: 63) have called *Gentianella* "a prominent representative of those plant taxa which have been postulated to have colonized the high mountain ranges of South America from North temperate regions."

About 100 species of *Gentianella* are known from Peru. Most of the Peruvian species are restricted to one or two departments, and some have been listed as being threatened or endangered (León et al., 2006). When the South American species of *Gentianella* (as *Gentiana* L.) were studied by Gilg (1916a) and the Peruvian species by Macbride (1959), much of the floristic exploration of the Peruvian Andes had been concentrated in the central and southern parts of the country, at sites above Lima and in the vicinities of Cusco, Arequipa, and Puno. New species of *Gentianella* have continued to be discovered in those regions, but in recent years a greater number of new species have been discovered in northern Peru, mostly from sites where there had been little or no floristic exploration until

recently. Moreover, as noted by Flores et al. (2005), the high-altitude wetlands in the Peruvian Andes, which are often the habitat of *Gentianella* species, including *G. empetroides* J. S. Pringle, described here, have remained relatively poorly known floristically. Botanists associated with the Missouri Botanical Garden, through both the William L. Brown Center and the Garden's biological station at Oxapampa, Peru, have contributed significantly to the knowledge of the flora of northern and central Peru. Four of the new species of *Gentianella* discovered by them are described here, three from northern Peru and one from central Peru.

Phylogenetic and other studies published during the past 20 years have raised concerns with regard to the appropriate circumscription of *Gentianella*, how the genus, when appropriately circumscribed, could be characterized morphologically, and whether taxonomic subdivisions of the genus should be recognized. Such concerns have led to questions as to whether the species described here, and some other recently described species, should be included in *Gentianella*. In accord with recommendations from reviewers, this paper addresses these and related concerns in a review of the taxonomic and nomenclatural history of *Gentianella*, with discussions of variation in morphology throughout its range.

Historically, as in Gilg's (1916a) taxonomic monograph on the South American species, the taxa now treated as *Gentianella* were usually included in *Gentiana*, often distinguished as a subgenus or section (reviewed by Gillett, 1957), although some early authors variously split *Gentiana* s.l. into several smaller genera. The early generic-level divisions of *Gentiana* s.l. found little acceptance, but during the last 50 years, following its acceptance by Börner (1912), Marquand (1931), Smith (1936), Fabris (1955), and Gillett (1957), *Gentianella* has become widely recognized as a genus distinct from *Gentiana*, more closely related to other genera, including *Halenia* Borkh., *Lomatogonium* A. Braun, and *Swertia* L. The separation of *Gentianella* from *Gentiana*, initially based on morphology, has been supported in phylogenetic studies by Yuan and Küpfer (1995), Struwe et al. (1998), Thiv et al. (1999), Favre et al. (2016), and Yang et al. (2016).

In the tribal and subtribal classification of the Gentianaceae presented by Struwe (2014) and Struwe and Pringle (Struwe & Pringle, in press), *Gentiana* and *Gentianella* are placed in different subtribes of the tribe Gentianeae. This classification, supported by phylogenetic studies (Yuan & Küpfer, 1995; Struwe et al., 2002; Yang et al., 2016), is, with regard to the subtribes of the Gentianeae, largely in harmony with earlier studies of morphology, anatomy, and palynology. In subtribe Gentianinae, of which *Gentiana* is the type genus, the basic components of the gamopetalous corolla, within which the primary veins are located, alternate with distally widening corolla tissue, infolded in bud, that is vascularized only by branches from the lateral petal veins on each side, the sole exception being in *Gentiana lutea* L. These components of the corolla, called plicae, usually extend into free portions between the corolla lobes. The nectaries are borne on the pistil on a stipe below the ovary, or, in those species of *Crawfurdia* Wall. with sessile ovaries, as a ring or cup at the base of the ovary. In subtribe Swertiinae (type genus *Swertia*), in which *Gentianella* is placed, there are no plicae in the corolla. Nectary position varies but is most often epipetalous, as it is in *Gentianella*.

The segregation of the genera *Comastoma* (Wettst.) Toyok. and *Gentianopsis* Ma, which likewise had been included in *Gentiana* and later in *Gentianella*, has also become widely accepted and has been supported by phylogenetic studies (Yuan & Küpfer, 1995; Hagen & Kadereit, 2001). *Comastoma* and *Gentianopsis*, genera native only to the Northern Hemisphere, are included in subtribe Swertiinae.

Adaxial trichomes or deeply fringed scales on the corolla have figured prominently in considerations of the phylogeny, classification, and circumscription of *Gentianella* and *Comastoma* (Huxley, 1888; Gillett, 1957; Hagen & Kadereit, 2001). In some species of *Gentianella* in the Northern Hemisphere, vascularized trichomes form a ring at or near the base of the corolla lobes, which consists of two nearly continuous groups of several trichomes, or two deeply fringed scales, near the base of each lobe. These species include, among others, the European *G. campestris* (L.) Börner, the type species of the generic name (as *G. tetrandra* Moench), and *G. amarella* (L.) Börner, a widespread species (s.l.) in North America and Eurasia. In other Northern Hemisphere species, including the widespread North American species *G. quinquefolia* (L.) Small, corolla trichomes are absent.

Many of the South American species of *Gentianella* lack corolla trichomes. Diverse forms of adaxial corolla trichomes occur among other South American species. A conspicuous ring of trichomes mostly 3–6 mm is present at the throat of the corolla in *G. nitida* (Griseb.) Fabris and *G. ruizii* (Griseb.) Holub, but in these species (as in *Comastoma*, but in contrast to *G. amarella*, *G. campestris*, and other Northern Hemisphere species) the trichomes are not vascularized (Hagen & Kadereit, 2001). In other South American species of *Gentianella* the trichomes, if present, are located nearer the base of the corolla, alongside and between the adnate portions of the filaments or, in some species with deeply lobed corollas, between the insertion of the filaments and the sinuses between the corolla lobes. In many species these trichomes are less than 0.5 mm. In some species the minute trichomes are few

and inconspicuous and may be absent in the smaller flowers; in other species they are more numerous. In yet other South American species the trichomes are not only numerous but also longer, to 3–5 mm in some Ecuadorean species. In no South American species of *Gentianella* are vascularized trichomes or scales on the corolla known to occur.

A few authors, including Rafinesque (1837–1838), Greene (1904), and Omer et al. (1988), have segregated the Northern Hemisphere species that lack corolla trichomes as *Aloitis* Raf. [type species *Aloitis quinquefolia* (L.) Raf.; ≡ *Gentianella quinquefolia*]. Greene also emphasized the orientation of the corolla lobes. Subsequent to their acceptance of *Aloitis*, Omer and Qaiser (1991) proposed a new genus, *Aliopsis* Omer & Qaiser, consisting of a single species, *Aliopsis pygmaea* (Regel & Schmalh.) Omer & Qaiser [≡ *Gentianella pygmaea* (Regel & Schmalh.) Harry Sm.]. *Aliopsis*, like *Aloitis*, was described as lacking adaxial corolla trichomes or scales but was said to differ from *Aloitis* in being monocarpic and in having equal calyx lobes, tetramerous rather than pentamerous perianths and androecia, and nectaries as many as the corolla lobes rather than twice as many. These alleged differences do not consistently distinguish *Aliopsis* from *Aloitis*, as *G. quinquefolia*, the type species of the generic name *Aloitis*, is likewise monocarpic; the calyx lobes are usually all similar in size and shape at least in the autonymic subspecies; the perianths and androecia are tetramerous; and the nectaries are isomerous with the corolla lobes. Other alleged differences, with regard to the styles, stigmas, and ovarian stipes, are likewise untenable, as considerable variation and intermediate character states exist among the other Northern Hemisphere species of *Gentianella*.

In all species of *Gentianella* in the Northern Hemisphere, the lobes of the corolla are shorter than or rarely about as long as the tube. In all of the Australian and New Zealand species, the lobes are much longer than the tube. In the South American species, the depth of corolla lobing varies greatly, with the lobes ranging from ca. 0.4 to ca. 6.5 times as long as the tube. Adams (1995) segregated the Australian and New Zealand species of *Gentianella* as *Chionogentias* L. G. Adams, which he distinguished from residual *Gentianella* by a combination of deeply lobed corollas (thus excluding the species that had been placed in *Aloitis*) with the absence of trichomes at the corolla throat. He commented that some of the South American species should probably be included in *Chionogentias*, but he did not mention any South American species by name, nor did he address the nomenclatural issues that might arise from their designation or discuss the implications for the dispersal history of the genus. Glenny (2004) subsequently rejected separate generic status for the Australian and New Zealand species, citing evidence from molecular phylogenetic studies in support of their retention in *Gentianella*. Another proposal to divide the genus, by Löve (1982, 1983), is discussed below. As Hagen and Kadereit (2001) and I (Pringle, 1995) have noted, these proposals to divide *Gentianella* (exclusive of *Comastoma* and *Gentianopsis*) were based largely or exclusively on regional material and did not consider intermediate species or species exhibiting different combinations of character-states that occur elsewhere in the range of the genus. Except in the long-ago treatments by Don (1837–1838) and Gilg (1916b), which have neither been followed by subsequent authors nor supported by recent phylogenetic studies, proposed generic-level taxonomic divisions have given no more than token attention, if any, to the South American species.

A molecular phylogenetic study by Hagen and Kadereit (2001) indicated that *Gentianella*, as the genus was generally circumscribed when they initiated their study, was polyphyletic. Some of the species that had been included in *Gentianella* clustered with species of *Comastoma*, *Lomatogonium*, or other Swertiinae rather than with the rest of *Gentianella*. As Hagen and Kadereit pointed out, the relatively few species that had rendered *Gentianella* s.l. polyphyletic were all Asiatic and were distinguishable morphologically by their being binectariate, i.e., having a pair of nectaries below each corolla lobe, as in *Comastoma*, whereas in the other species of *Gentianella*, it was believed at the time, there was a single nectary below each corolla lobe. Unlike *Comastoma*, the binectariate Asiatic species lack trichomes or fringed scales near the base of the corolla lobes. The appropriate taxonomic placement (or placements) of these binectariate Asiatic species, at least in some cases, is yet to be determined.

With the binectariate Asiatic species excluded, *Gentianella*, as represented in Hagen and Kadereit's study, was shown to be monophyletic. This was presented by Hagen and Kadereit as "a new circumscription of the genus," which they designated *Gentianella* s. str. (2001: 63). Because of the morphological similarity among the species retained by them in *Gentianella*, they considered it unlikely that the inclusion of more species in such studies would break this monophyly.

Hagen and Kadereit's study further indicated that within *Gentianella* s. str. each of the two groups of Northern Hemisphere species that have been treated by some authors (discussed below) as sections, defined, respectively, by the presence or absence of vascularized trichomes at the throat of the corolla, and with both of these sections including North American and Eurasian species, was also largely monophyletic. The western North American species *G. microcalyx* (Lemmon) J. M.

Gillett was an exception, clustering among the species with corolla trichomes although lacking trichomes itself. Another subordinate clade within *Gentianella* s. str. consisted of all of the Australian and New Zealand species represented in Hagen and Kadereit's study and included no species native to South America or any other region. None of these subordinate clades within *Gentianella* s. str. was differentiated at a level otherwise associated with the distinction of genera in the Swertiinae.

Seventeen South American species of *Gentianella* were represented in Hagen and Kadereit's study. Within South American *Gentianella* there are several groups of species that appear from morphology to be closely related, such as a group of gynodioecious or otherwise florally heteromorphic species with yellow or white corollas, including, among others, *G. chrysantha* (Gilg) T. N. Ho & S. W. Liu, *G. florida* (Griseb.) Holub, and *G. pluvialis* J. S. Pringle; several species with scarcely opening corollas longitudinally striped scarlet and yellow, including *G. erythrochrysea* (Gilg) Fabris, *G. hirculus* (Griseb.) Fabris, and *G. zaratei* J. S. Pringle; the two species *G. galtonioides* J. S. Pringle and *G. kusnezowii* (Gilg) T. N. Ho & S. W. Liu, both of which have numerous linear to narrowly lanceolate basal leaves and an elongate thyrse of mixed tetramerous and pentamerous flowers; and the species with stiff, often proximally woody stems and many narrow, closely spaced leaves, including *G. graminea* (Kunth) Fabris, *G. oreosilene* (Gilg) J. S. Pringle, and *G. radicata* (Griseb.) J. S. Pringle (Pringle, 2011, 2014, 2015, 2016a, 2016b). In Hagen and Kadereit's study, such groups were not represented or were represented by only one species, so hypotheses as to the relationships in these groups were not tested in that study.

As Hagen and Kadereit noted, the limited ITS variation among the South American species of *Gentianella* has left the phylogeny of these species largely unresolved. Similar limitations were encountered with *mat*K and combined *mat*K/ITS data. The combination of little ITS variation with the presence of a large number of species in South America was attributed largely to the existence of an extensive geographic area offering diverse, fragmented, high-altitude habitats, newly available for colonization following the arrival of *Gentianella* in that continent (Hagen & Kadereit, 2001; Kadereit & Hagen, 2003). The increase in endemism with elevation has been discussed in several recent publications (e.g., Hughes & Eastwood, 2006; Hoorn et al., 2013; Hughes & Atchison, 2015; Favre et al., 2016). The Andes represent a relatively recent uplift, and the highest elevations, as indicated by these studies, have functioned as an archipelago of biogeographic "islands" in which many endemic high-altitude species have evolved. Notably, the paper by Hughes and Eastwood deals with relatively recent "explosive plant species diversification" at high elevations in the Andes in *Lupinus* L. (Fabaceae), another flowering-plant genus believed to be of Northern Hemispherical origin (2006: 10334). The high-altitude peaty wetlands, called bofedales or oconales, scattered among drier habitats, are especially significant as "biodiversity hotspots" (Maldonado Fonkén, 2014).

Research on South American *Gentianella* subsequent to Hagen and Kadereit's (2001) phylogenetic study, especially the descriptions of new species, has added appreciably to the morphological diversity known to exist in the genus. Significantly in relation to the characterization and circumscription of *Gentianella*, in some of the more recently described species the nectariferous tissue below each corolla lobe is divided into two more or less distinct parts by the petal midvein, sometimes to the extent that two separate nectaries can be distinguished, as previously described in *G. decemnectaria* J. S. Pringle, *G. glenniae* J. S. Pringle, and *G. grantii* J. S. Pringle (Pringle, 2011, 2016a; Pringle & Grant, 2012) and noted in this paper in *G. bussmannii* J. S. Pringle. As single rather than paired nectaries had been considered to define *Gentianella* s. str. "unambiguously" (Hagen & Kadereit, 2001: 72), these discoveries have raised questions as to whether these species should be included in *Gentianella*, and to what extent, if at all, the occurrence of single versus paired nectaries should be regarded as a generic-level character in the Swertiinae.

To date, none of the binectariate South American species of *Gentianella* has been sequenced for phylogenetic studies. In other genera in the Swertiinae, the occurrence of single versus paired nectaries on or below each corolla lobe has generally not been accepted as a generic-level distinction. Liu and Ho (1992), in their systematic study of *Lomatogonium*, included both uninectariate and binectariate species in that genus. In *Swertia* and genera sharing similar floral morphology, including *Frasera* Walter and *Veratrilla* Franch., in which a nectary is located in a pit, called a fovea, between the abaxial and adaxial corolla surfaces, opening either immediately or distally adaxial to the nectary itself, the foveal morphology ranges, in the respective species, from two separate foveae on each corolla lobe, each with one nectary, through two nectaries at the bilobed base of a single fovea, to one fovea containing a single nectary on each corolla lobe, as indicated in Smith's (1970) descriptions of *Swertia* spp. and Holmgren's (1984) descriptions of *Frasera* spp. Within some species in this group of genera, including *S. asarifolia* Franch. (*S. atroviolacea* Harry Sm.) and *V. baillonii* Franch., the foveae on each corolla lobe vary in the extent to which they exist as two separate foveae or are partially or completely fused

(Smith, 1936; Ho & Pringle, 1995). The binectariate South American species of *Gentianella* are diverse in morphology, and no shared feature of their morphology suggests that they should be transferred to any other genus or that they should be treated collectively as a distinct genus.

Most of the subgeneric and sectional names associated with *Gentianella* have been used either within the historic concept of *Gentiana*, to distinguish *Gentianella* and other groups from the species now retained in *Gentiana*, or more recently within a broader concept of *Gentianella*, to distinguish *Comastoma* and *Gentianopsis* from the species now retained in *Gentianella* (reviewed by Gillett, 1957). Grisebach (1838) placed species now referable to *Gentianella* s. str. in four sections of *Gentiana* s.l. *Gentiana* sect. *Amarella* Gaudin comprised the Northern Hemisphere species with a ring of trichomes or fringed scales at the throat of the corolla, including *Gentiana campestris* L., and also encompassed present-day *Comastoma*. *Gentiana* sect. *Arctophila* Griseb., which current rules of nomenclature require be typified by *Gentiana arctophila* Griseb. (now included in *Gentianella propinqua* (Richardson) J. M. Gillett), consisted of the Northern Hemisphere species without corolla trichomes. All but one of the South American species, along with the species now called *Gentianella diemensis* (Griseb.) J. H. Willis and *Gentianella saxosa* (G. Forst.) Holub, native, respectively, to Tasmania and New Zealand, were placed in *Gentiana* sect. *Andicola* Griseb. Holub (1967), upon transferring these sections to *Gentianella*, lectotypified this sectional name by the South American species *Gentiana diffusa* Kunth [= *Gentianella rapunculoides* (Willd. ex Schult.) J. S. Pringle]. The South American species now called *Gentianella magellanica* (Gaudich.) Fabris ex D. M. Moore and a taxon now considered conspecific with it were placed in *Gentiana* sect. *Antarctophila* Griseb., along with the New Zealand species now called *Gentianella montana* (G. Forst.) Holub, which Holub designated the lectotype. (This grouping was not supported by Hagen and Kadereit's study [2001].) Later, Grisebach (1845) extracted *Gentiana thyrsoidea* Hook. [≡ *Gentianella thyrsoidea* (Hook.) Fabris], a Peruvian species, from *Gentiana* sect. *Andicola* and placed it in the monotypic *Gentiana* sect. *Dasystephana* Griseb. (This sectional name was used without explanation. The section did not include the type of the generic name *Dasystephana* Adans., although Grisebach included *Dasystephana* Adans. in his circumscription of *Gentiana*.) The Peruvian species *Gentianella ruizii* (as *Gentiana ruizii* Griseb.), which had not been included in Grisebach's earlier work, was placed in *Gentiana* sect. *Amarella* because of the ring of trichomes at the throat of the corolla, although *Gentiana nitida* Griseb. was retained in *Gentiana* sect. *Andicola*. Grisebach's descriptions of the sections did not explicitly indicate any consistent morphological differences between *Gentiana* sect. *Andicola* and the supposedly less variable *Gentiana* sect. *Antarctophila*.

Kusnezow's (1895) division of *Gentiana* subg. *Gentianella* (the combination attributed by Kusnezow to himself, although earlier authors had likewise employed the epithet at subgeneric rank in *Gentiana*) into sections followed Grisebach (1845). Hegi's (1927) and Grossheim's (1967) treatments of *Gentiana* s.l., which dealt only with European and Asiatic species, were similar, except that the section comprising the species with vascularized corolla trichomes was designated *Gentiana* sect. *Endotrichae* Froel. That name is superfluous, as the section, when thus named, included *Gentianella campestris* (as *Gentiana*).

Gillett (1957), in a monograph on the North American species, treated *Comastoma*, *Gentianopsis*, and *Gentianella* s. str., respectively, as three subgenera of *Gentianella*. Within subgenus *Gentianella* he recognized *Gentianella* sect. *Amarella* (Gaudin) J. M. Gillett, which included all of the North American species in that subgenus. This section was divided into *Gentianella* ser. *Amarella* (Gaudin) J. M. Gillett, comprising the Northern Hemisphere species with vascularized corolla trichomes, and *Gentianella* ser. *Arctophila* (Griseb.) J. M. Gillett, comprising the Northern Hemisphere species without corolla trichomes. Except for a statement that the South American species of *Gentianella* were "placed chiefly in sections *Imaicola* and *Andicola*," Gillett did not discuss the relationships of species in the Southern Hemisphere (1957: 206). (*Gentiana* sect. *Imaicola* Griseb. was established by Grisebach (1845) for two species, both Himalayan, neither of which is now included in *Gentianella*. No other species have been placed in this section, and it has not been recognized in recent literature. The sectional name was never transferred to *Gentianella*.)

In 1982, Löve raised *Gentiana* sect. *Arctophila* Griseb. to generic status as *Arctogentia* Á. Löve, the epithet *Arctophila* not being available for use at generic rank. Into *Arctogentia* he transferred *Gentianella propinqua* and *G. aurea* (L.) Harry Sm. ex Hyl., both of which are Northern Hemisphere, uninectariate species lacking corolla trichomes. Later, Löve (1985) rejected the name *Arctogentia* and included these two species, along with *G. quinquefolia*, in *Aloitis*. Grisebach's *Gentiana* sect. *Antarctophila*, still comprising all but two of the Australian and New Zealand species plus *Gentianella magellanica*, was treated by Löve (1983) as a genus, called "*Oreophylax*." That generic name, and consequently the specific combinations under it, were never validly published. (The epithet *Oreophylax* had been applied by Endlicher in 1838 [1836–1850]

to an unranked subdivision of *Gentiana* but had not otherwise been used in the taxonomy of the Gentianaceae.) These nomenclatural innovations were published in papers on chromosome numbers, but these were not a consideration in Löve's distinction of *Aloitis* and "*Oreophylax*," as $x = 9$ prevails in both groups.

There have been no recent, geographically comprehensive proposals to divide *Gentianella*, as circumscribed by Hagen and Kadereit (2001), into subgenera, sections, or series. To date, the polytomies, the limited representation of species seemingly grouped by shared morphology, and the omission of some morphologically unusual species indicate that molecular phylogenetic studies have not yet been sufficiently inclusive to contribute significantly to the taxonomy of the South American species at this level. The occurrence of similar character-states in different combinations rather than consistently in syndromes, some examples of which are noted in this paper, would present difficulties in establishing satisfactory generic subdivisions from morphology alone.

Although Hagen and Kadereit's "new circumscription" of *Gentianella* is accepted here, my description of the genus *Gentianella* published in 1995 remains applicable in the present context, as does the generic-level synonymy. "Synoecious," "gynodioecious," and other terms relating to floral heteromorphy are used here as defined by Kiger and Porter (2001). The species with which the new species are contrasted, if known in 1916, were described by Gilg (1916a, as *Gentiana*; the specific epithets remain unchanged) or in references cited by him. The Peruvian species known at the respective times were also described by Macbride (1959), the Argentinian species by Filippa and Barboza (2006), and the Ecuadorean species by me (Pringle, 1995). References to descriptions of species named more recently are cited in the text.

1. Gentianella bussmannii J. S. Pringle, sp. nov. TYPE: Peru. Amazonas: Prov. Chachapoyas, Distr. Leimebamba, trail to Laguna de Los Cóndores, surroundings of Laguna Esperanza/Siete Lagunas, 06°48′44″S, 077°42′59″W, 26 June 2010, *R. W. Bussmann, A. Glenn, C. Chait & C. Vega Ocaña 16448* (holotype, MO- 6607210!; isotypes, HAM!, HAO not seen, MO-6607439!). Figure 1.

Herba verosimiliter synoecia, quae a congeneris caule erecto, foliis caulinis linearibus apice peracuminatis, floribus cernuis in cymas paucifloras dispositis, corolla campanulata, 3–5 cm longa, pro parte maxima coccinea sed intus inter nervos aurea et corollae lobis tubum aequantibus vel tubo parum brevioribus distinguitur.

Perennial herbs, synoecious to the extent known (limited material was available for examination). Stems 30–100 cm, erect, simple below the inflorescence, glabrous, at least proximally suffused with purplish red, especially at the nodes, proximally ca. 2.5 mm diam.; proximal internodes 4–20 mm, gradually transitional to distal internodes 5–9 cm. Leaves all cauline, opposite, medium green, often reddish toward the apex, firm-textured, glossy, linear, 25–50 mm, 1.5–4 mm wide at base, 1–3 mm wide distally but ± conduplicate and consequently appearing narrower, gradually transitional to narrowly lanceolate bracts 15–25 × 1.5–2.5 mm in the inflorescence, only the midveins conspicuous, bases appressed but not connate-sheathing, margins smooth, apices acuminate. Inflorescence an open cyme, usually simple and racemoid, occasionally a 1- or 2-branched cyme of 3 to 5 flowers, flowers either paired or solitary at the nodes; nodding, on pedicels 12–25 mm (pedicels appearing longer when a solitary flower terminates a branch bearing small bracts); flowers pentamerous; calyx 12–20 mm, veins scarcely raised abaxially, only the midveins prominent, tube campanulate, 4–6.5 mm, adaxial colleters present near the base of the tube, lobes all similar, very narrowly triangular, 10–15 mm, 1.5–2 mm wide at base, 1.7 to 2.7 times as long as the tube, erect or spreading slightly toward the apex, margins smooth, apices acuminate; corolla abaxially predominantly bright red, adaxially red along the primary veins and toward the apices of the lobes, largely yellow between the primary veins, 30–50 mm, 2.3 to 3.2 times as long as the calyx, campanulate, tube narrowly obconic, 18–20 mm, 7–10 mm diam. at the summit, lobes spreading, elliptic-ovate, 16–20 mm, 6–8 mm wide at the widest point slightly below mid-length, 0.8 to 1 times as long as the tube, apex entire, adaxial trichomes absent; filaments inserted at ca. 0.3 times the height of the tube, 15–20 mm, anthers 3.5–4 mm, dark purple; nectaries 10, those of each pair distinctly separated, oblong-lanceolate, ca. 0.8 mm; pistil dark greenish purple, ovary stipitate at anthesis. Mature capsule and seeds not seen.

Habitat, distribution, and phenology. *Gentianella bussmannii* is known only from the type locality in Amazonas Department, Peru. Its habitat there was a partly burnt *Neurolepis* Meisn. páramo with small forest fragments on limestone at 3275–3500 m (*Bussmann et al. 16448*, in sched.), where this species was in flower in June. Its having been found in only one locality to date, despite its showiness, suggests that its distribution is narrowly limited, and that the species would appropriately be of conservation concern.

A remarkable diversity of *Gentianella* species has been found at this locality, in an area described as quite remote and uninhabited (A. Glenn, pers. comm.), including *G. bussmannii* (type locality), *G. decemnectaria* (type locality), *G. glenniae* (paratype locality), *G.*

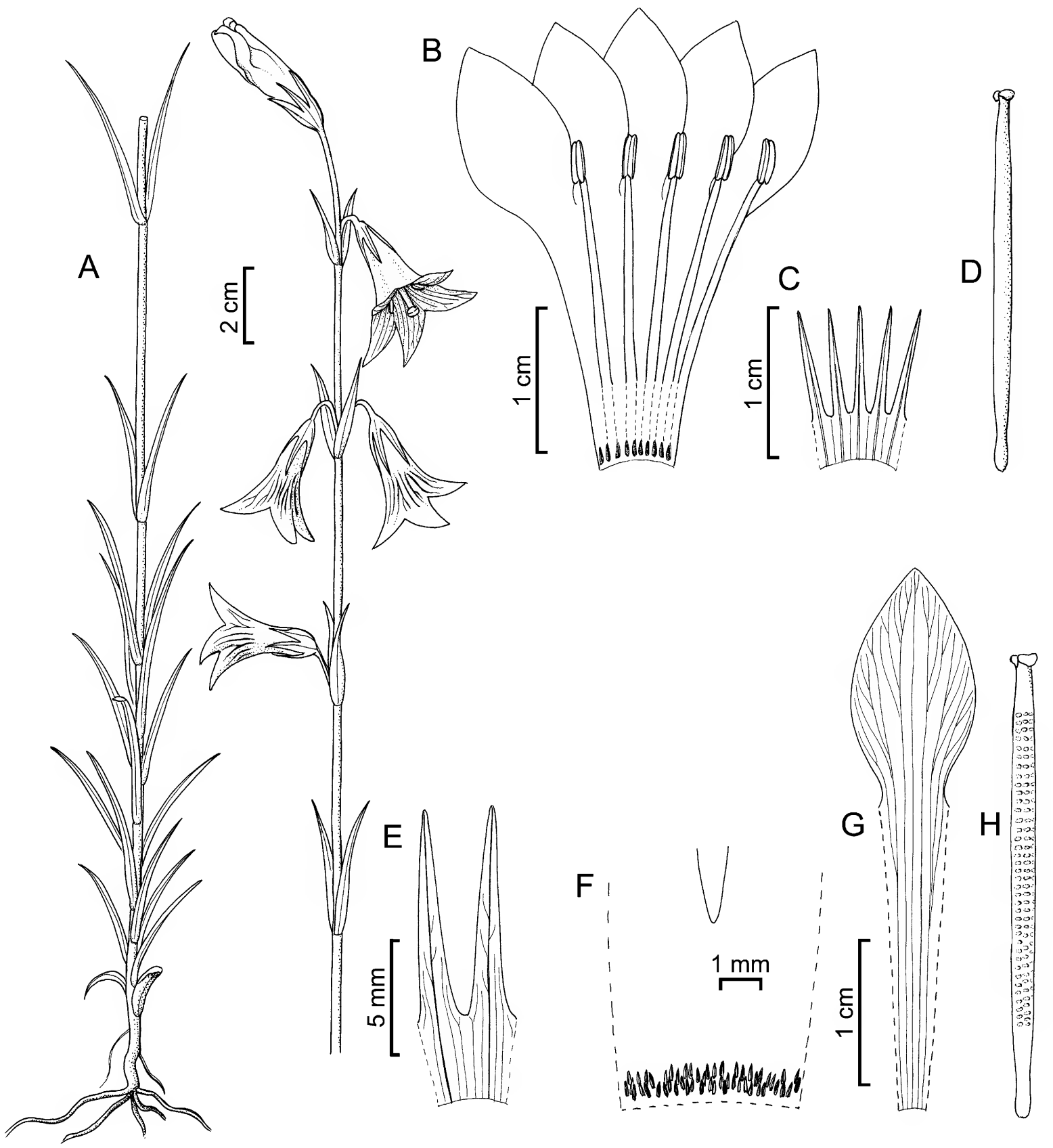

Figure 1. *Gentianella bussmannii* J. S. Pringle. —A. Plant. —B. Adaxial view of corolla, with stamens and nectaries. —C. Abaxial view of calyx of same flower. —D. Pistil. —E. Portion of calyx of another flower. —F. Adaxial view of the base of a portion of the calyx, showing colleters. —G. Adaxial view of a portion of the corolla showing venation. —H. Pistil, longitudinal section. C, D to same 1-cm scale; G, H to same 1-cm scale. Drawn from *Bussmann et al. 16448* (HAM, MO).

pernettyoides (Reimers) Fabris (first record for Amazonas Department, *Bussmann et al. 16511*, HAM, MO), and *G. quipuscoana* J. S. Pringle (type locality), with *G. chamuchui* (Reimers) Fabris (first record for Amazonas Department, *Bussmann et al. 15847*, HAM, MO), *G. raimondiana* (Wedd.) J. S. Pringle (first records for Amazonas Department, *Glenn et al. 393* and *Bussmann et al. 15724*, both HAM, MO), and *G. speciosissima* (Gilg) Zarucchi being present at nearby sites. As several additional species of *Gentianella* are known from other localities in Chachapoyas Province, it is likely that more species of *Gentianella* are native to this province, with an area of ca. 3312 km^2, than to any other area of comparable size.

Etymology. *Gentianella bussmannii* is named for the primary collector of the type specimens, Dr. Rainer W. Bussmann, Director of the William L. Brown Center, Missouri Botanical Garden, a distinguished ethnobotanist, ecologist, and conservationist noted for his studies in South America, Asia, continental Africa, and Madagascar.

Discussion. The flowers of *Gentianella bussmannii* are similar in appearance to those of *G. cernua* (Kunth) Fabris and *G. splendens* (Gilg) Fabris. Those species, both of which are native to the central Ecuadorean Andes, likewise have nodding flowers similar in size to those of *G. bussmannii* and campanulate, red corollas, although the corollas of those species are somewhat more deeply lobed than those of *G. bussmannii*. *Gentianella cernua* is lower in stature than *G. bussmannii*, with flowering stems to 25 cm; its leaves, which are mostly basal or nearly so, are elliptic-oblong to ovate, rounded or subacute at the apex; and its flowers are often solitary. *Gentianella splendens*, being taller, is more similar to *G. bussmannii* in habit and in its several-flowered inflorescences but differs in its lanceolate to narrowly ovate-triangular leaves 3–8 cm × 5–25 mm. Adaxial trichomes 0.5–2 mm are present in the corolla tubes of both *G. cernua* and *G. splendens* but are absent in *G. bussmannii*.

Vegetatively, *Gentianella bussmannii* is more similar to several species native to Peru and Ecuador that have numerous firm, narrow, acute-tipped leaves closely spaced proximally and gradually more widely spaced distally, although the plants of *G. bussmannii* are taller and the leaves are somewhat larger. One such species is *G. corallina* (Gilg) Zarucchi, which, like *G. bussmannii*, is native to Chachapoyas Province and has nodding flowers in few-flowered cymes, with reddish corollas lobed approximately to mid-length. *Gentianella corallina* differs in its lower stature, with proximally woody stems to ca. 30 cm, more compact inflorescences, and corollas 12–20 mm. Other vegetatively similar species are generally of lower stature and differ distinctly from *G. bussmannii* in the form of the inflorescence, the orientation of the flowers, and the size, lobing, and color of the corollas.

2. Gentianella empetroides J. S. Pringle, sp. nov. TYPE: Peru. La Libertad: Prov. Bolívar, alpine bogs around Río Negro & Pampa Uchulala along rd. to Bambamarca, 07°13′51″S, 077°38′21″W, 3 June 2015, *C. Vega Ocaña, R. W. Bussmann, M. Paniagua Zambrana, F. Díaz Llajo & F. Díaz Vega 446* (holotype, MO!; isotype, HAO, image!). Figure 2.

Suffrutex humilis *Gentianellae quipuscoanae* J. S. Pringle verosimiliter affinis, sed ab ea caulibus glabris, foliis angustioribus, et floribus majoribus in cymulas densiores dispositis differens.

Subshrubs, synoecious as far as is known (see discussion). Plants 10–25 cm; stems glabrous, 1 to several at base, proximally 1.5–2 mm diam., variously branching but generally with several ± equal branches diverging near mid-height. Leaves all cauline, opposite, ± evenly spaced, with mostly 3 or 4 nodes per cm on fully elongated stems, or slightly more widely spaced distally but all leaves generally longer than the internodes they subtend; all but near-basal leaves generally persistent at flowering time; leaves all similar, ascending, straight or sometimes ± arcuate above the narrowed base, linear to narrowly elliptic-rhombic, 5–10 × 0.8–1.8 mm, proximally narrowed and more strongly ascending but not distinctly divided into petiole and lamina, margins smooth, apices appearing acute but obtuse to subacute as seen at 30×, bases not connate-sheathing; leaves and calyces somewhat coriaceous, with a varnished appearance. Flowers in dense clusters of 2 to 15 at ends of major branches, each inflorescence consisting of several very short branches; pedicels 0–5 mm; flowers pentamerous; calyx 6–9 mm, with dark purple infusion proximally along major veins and distally throughout, midveins and fused commissural veins raised, tube obconic, 2.5–3.5 mm, lobes linear to very narrowly triangular, 4–6 mm, 1–1.4 mm wide at base, 1.6 to 3 times as long as the tube, adaxial colleters few, in a narrow zone near the base of the tube; corolla pale purple with the major veins outlined in dark purple, and with a dark purple suffusion distally along the margin exposed in bud, widely campanulate to nearly rotate, 14–20 mm (measured closed), opening to 15–20 mm diam. (measured fresh), tube obconic, 4–6 mm, lobes spreading, narrowly spatulate-elliptic, 11–14 × 3.5–5 mm, 3 to 3.7 times as long as the tube, widest at 0.65 to 0.75 times length, apex obtuse, entire or very shallowly undulate, adaxial trichomes absent; stamens inserted ca. 0.5 mm below the corolla sinuses, 4–5 mm, anthers ca. 1.5 mm, purple; nectaries 5, ca. 1 mm, distally notched; ovary short-stipitate at anthesis. Mature capsule and seeds not seen.

Habitat, distribution, and phenology. *Gentianella empetroides* is known only from the type collection. At that locality, in the northeastern panhandle of La Libertad Department, Peru, it was found in an alpine bog among patches of *Sphagnum* L., at 3750 m. Flowers and young fruits were present in early June. This species was found in a region that has had little botanical exploration. The absence of other known collections suggests that this species is of narrow distribution and would appropriately be of conservation concern. Moreover, Flores et al. (2005) and Maldonado Fonkén (2014) have noted the vulnerability of high-Andean wetland plant communities and their component species to grazing pressure and other threats.

Etymology. *Gentianella empetroides* is named for the similarity in aspect of its vegetative parts to those of the crowberries, *Empetrum* L. spp. (Ericaceae, tribe Empetreae), native farther south in South America as well as in the South Atlantic islands and in the Northern

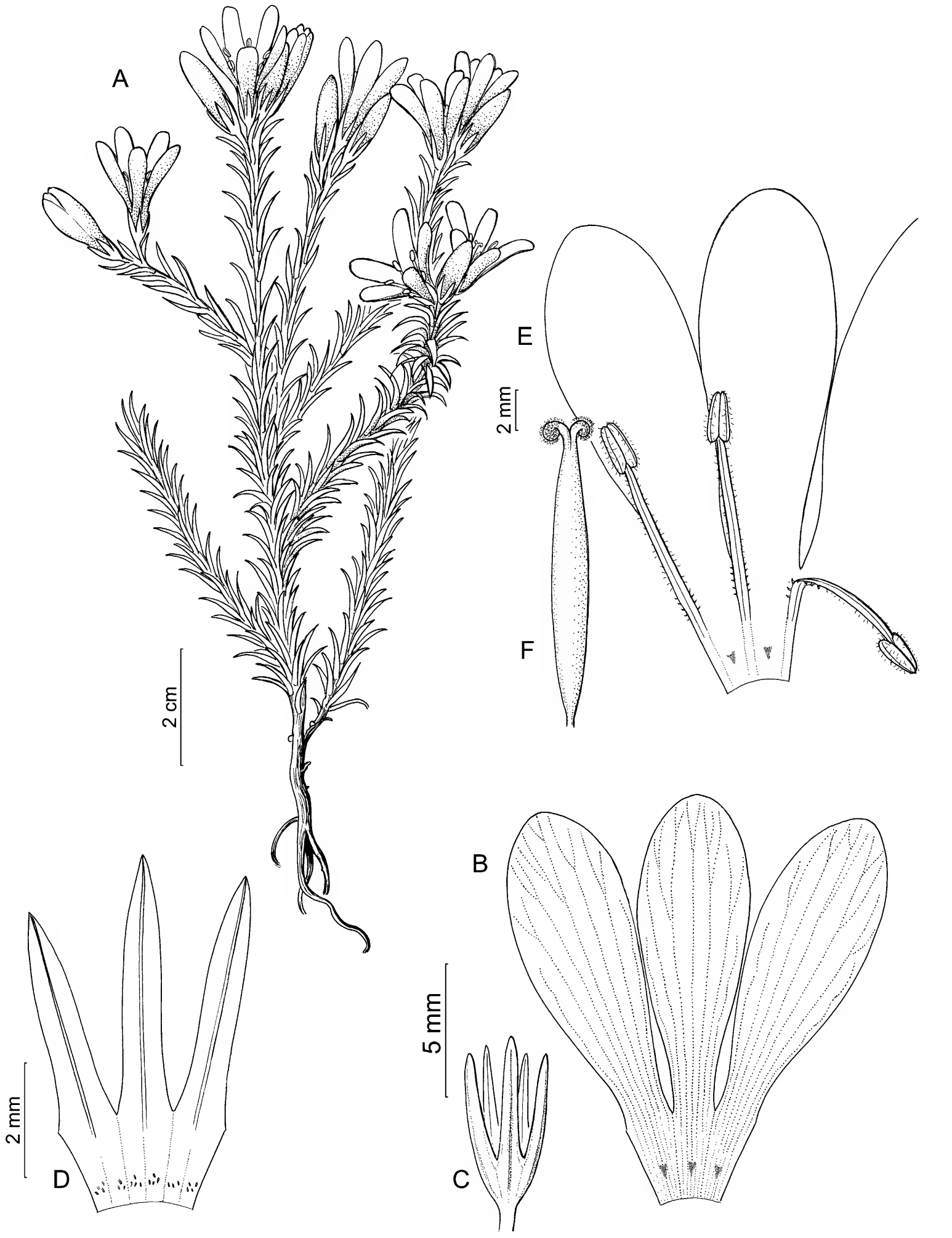

Figure 2. *Gentianella empetroides* J. S. Pringle. —A. Plant. —B. Portion of corolla. —C. Intact calyx. —D. Adaxial view of a portion of the calyx, showing colleters. —E. Adaxial view of a portion of the corolla, with stamens. —F. Pistil at anthesis. Drawn from *Vega Ocaña et al. 446* (MO).

Hemisphere. Like the crowberries, this species, similar in habit, occupies a damp, treeless habitat.

Discussion. *Gentianella empetroides* is one of a group of South American, mostly Peruvian, species of *Gentianella* characterized by a combination of stems that are firm and often woody near the base; numerous relatively small, narrow, somewhat coriaceous leaves, which are closely spaced at least on the proximal part of the stems; inflorescences of several to many relatively

small flowers; and corollas without adaxial trichomes. Other species sharing these morphological features have previously been discussed and contrasted (Pringle, 2016a, 2017). Of all the known species in this group, *G. empetroides* has the shortest, narrowest, and most closely spaced leaves.

The species with which *Gentianella empetroides* appears to have the most in common morphologically is *G. quipuscoana* J. S. Pringle (described and illustrated in Pringle, 2017), which is likewise native to northern Peru. Both of these species are subshrubs with similar branching patterns. Both have leaves that are closely spaced the whole length of the stems; corymboid rather than proportionately more elongated inflorescences; pale purple corollas with the major veins outlined in dark purple; and deeply lobed corollas with narrow, widely spreading lobes. In its aspect, *G. empetroides* differs distinctly from *G. quipuscoana* in that its leaves are more closely spaced, less widely spreading, consistently narrower, and averaging shorter. It differs further in its smooth rather than papillose-scabridulous stems; fewer flowers in denser cymules; larger flowers; and filaments inserted nearer the sinuses of the corolla, shorter than those of the bisexual flowers of *G. quipuscoana*. In *G. quipuscoana* the nodes of the fully elongated stems are mostly one to three per centimeter; the leaves are 6–10 × 1.5–3 mm, widely spreading, and generally distinctly arcuate; the pedicels are 3–11 mm; and the filaments in the bisexual flowers, above the level of insertion, are 5–7 mm. *Gentianella radicata*, of central Peru, differs from *G. empetroides* in having stems proximally less than 1.5 mm in diameter, only one or two nodes per centimeter distally on fully elongated flowering stems, minutely papillose-scabridulous stems and leaf margins, and leaves 10–15 × 1–2 mm, with acuminate apices.

Additional specimens of *Gentianella empetroides* will be required to permit certainty as to the breeding system of this species. Most species of *Gentianella*, in South America and elsewhere, are synoecious, with monomorphic flowers, but some species, otherwise diverse in morphology, are gynodioecious or gynomonoecious, or exhibit other breeding systems. Within the group of species to which *G. empetroides* appears to be most closely related, most are synoecious, but *G. quipuscoana* and *G. dacrydioides* (Gilg) Weaver & Rüdenberg, the latter native to Colombia and Ecuador, are gynodioecious (Pringle, 2017).

3. Gentianella nephostelium J. S. Pringle, sp. nov. TYPE: Peru. Amazonas: Prov. Luya, [Municipalidad Distrital] Conila-Chohechan, 06°14′27″S, 078°02′25″W, 23 Aug. 2012, *R. W. Bussmann, N. Paniagua Zambrana & C. Vega Ocaña 17247* (holotype, MO-6607228!; isotypes, HAM!, HAO not seen, MO-6607229!). Figure 3.

Herba verosimiliter synoecia, quae a congeneris caule erecto et crasso, foliorum basalium rosula persistente, foliis caulinis ovatis vel oblongo-lanceolatis apice acutis, floribus in thyrsos multifloros dispositis, calycis lobis ovato-triangularibus, corolla campanulata, alba sed secus venas cyanoviolacea, 18–25 mm longa et corollae lobis quam tubo triplo longioribus distinguitur.

Herbs, duration unknown, perhaps perennial eventually with a several-cipital caudex, synoecious to the extent known (limited material was available for examination). Root stout, internally bright yellow. Stems 40–120 cm, erect, fistulose, simple below the inflorescence, glabrous, proximally 5–10 mm diam.; proximal internodes (above basal rosette) 3–12 cm, gradually transitional to distal cauline internodes 3–6 cm and internodes ca. 1 cm in the terminal portion of the inflorescence. Leaves dark green, firm-textured, bases not connate-sheathing, margins smooth, apices acute to short-acuminate; basal leaves numerous, usually 20 to 40, in a dense rosette persistent at flowering time, oblong, 6–10 cm × 10–30 mm, 7- to 11-nerved; cauline leaves opposite, proximal cauline leaves oblong-lanceolate, transitional to ovate distal leaves 3–4.5 cm × 15–25 mm. Inflorescence a columnar thyrse of 35 to 70 or more flowers in the axils of the main stem and on short branchlets with ovate bracts; branching of inflorescence anisocladous, most nodes of primary axis with a bracteate branch with 2 to 4 nodes constituting a cymule of 3 to 9 flowers, opposite a shorter branch, sometimes with only a near-basal pair of bracts directly subtending a solitary flower or an umbelloid cymule of 2 or 3 flowers; pedicels slender, mostly 5–25 mm, proximal pedicels occasionally to 50 mm; flowers pentamerous; calyx 9–14 mm, veins scarcely raised, only the midveins prominent but margins of outer sepals decurrent as ridges along the tube, tube widely campanulate, 3–4 mm, adaxial colleters few and inconspicuous, lobes all similar, ovate-triangular, 5–10 mm, 3–6.5 mm wide at the widest point (width scarcely varying from just above the base nearly to mid-length), 1.5 to 2.6 times as long as the tube, erect, margins smooth, apices short-acuminate; corolla white with the veins proximally dark purple, campanulate, 18–25 mm (measured closed), 1.8 to 2.2 times as long as calyx, tube bowl-shaped, 2–4 mm, 7–10 mm diam. at the summit, lobes widely elliptic-rhombic, 16–19 mm, 11–17 mm wide ca. mid-length, 5 to 5.5 times as long as the tube, apex entire, adaxial trichomes absent; stamens inserted at ca. 0.7 times the height of the tube, filaments 11–14 mm, anthers bluish black, 2.5–3 mm; nectaries 5, ca. 1.8 mm, extending distally along the sides of the adnate portions of the stamens; pistil with a dark

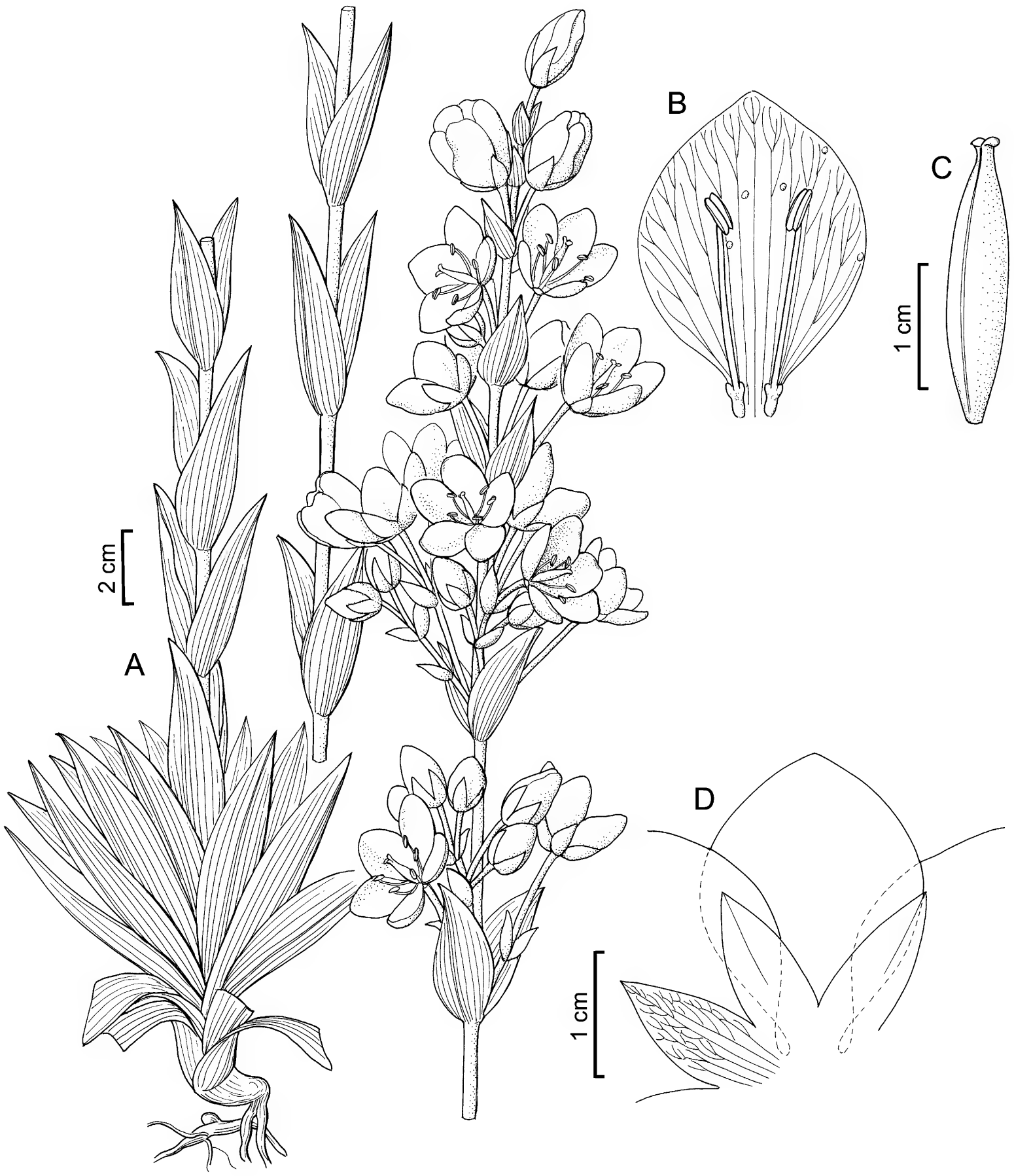

Figure 3. *Gentianella nephostelium* J. S. Pringle. —A. Plant. —B. Adaxial view of portion of corolla, with stamens and nectaries. —C. Pistil. —D. Abaxial view of portion of flower, showing calyx lobing and venation. Drawn from *Bussmann et al. 17247* (HAM, MO).

purple stigma, ovary subsessile at anthesis. Mature capsule and seeds not seen.

Habitat, distribution, and phenology. *Gentianella nephostelium* is known only from the type locality in Amazonas Department, northern Peru, where its habitat was upper cloud forest and páramo at 3261 m (*Bussmann et al. 17247*, in sched.). The plants were in flower when the type specimens were collected in August. Like *G. bussmannii*, *G. nephostelium* is a showy species that has been found in only one locality to date, suggesting that it, too, has a narrowly limited distribution and would appropriately be of conservation concern.

Etymology. The specific epithet is from the Greek *nephos*, cloud, and *stele*, column, with a diminutive suffix. In 2011, I gave the name *Gentianella pyrostelium* to a species native to northern Peru with a columnar

inflorescence and red-and-yellow corollas, with the specific epithet, inspired by Exodus 13:21–22, meaning "a little pillar of fire"; now, with the naming of this species with predominantly white corollas, there is also "a pillar of cloud." Being a noun in apposition rather than an adjective, the epithet retains the Greek suffix *-ium* rather than ending in *-a*.

Discussion. *Gentianella nephostelium* is one of several species of *Gentianella* in Peru with relatively tall, stout, erect stems, a persistent rosette of many large basal leaves, and relatively large flowers in many-flowered thyrses. Among these, both *G. formosissima* (D. Don ex G. Don) Fabris ex J. S. Pringle, of central Peru, and *G. profusa* J. S. Pringle, of southern Ecuador, differ from *G. nephostelium* and the other species in this group in their open, widely branched inflorescences, with the pedicels 3–10 cm. *Gentianella formosissima* further differs from *G. nephostelium* in its larger flowers, with violet corollas 3–5 cm, and *G. profusa* differs in its rose-violet corollas. The sympatric *G. speciosissima* differs from *G. nephostelium* in its arcuate leaves 3–7 mm wide, inflorescences with the branching mostly isocladous, and lilac to rose-violet corollas with the lobes 2 to 2.5 times as long as wide. In *G. chamuchui*, another sympatric species, the inflorescence is less elongated, with most of the flowers in a terminal umbelloid cyme, and the corollas are rose-violet, with the lobes 2.3 to 3 times as long as wide and 2 to 2.5 times as long as the tube. *Gentianella crassicaulis* J. S. Pringle and *G. weberbaueri* (Gilg) Fabris, of northern and central Peru, respectively, have corolla lobes shorter than the tube as well as deeply pigmented corollas. The sympatric *G. decemnectaria* (described in Pringle, 2011) has flowers similar in size to those of *G. nephostelium*, with widely campanulate to nearly rotate corollas and widely obovate corolla lobes, but differs from *G. nephostelium* in its blue-violet corollas and from all of the other species mentioned in this comparison, including *G. nephostelium*, in its proximally more slender, more or less scandent stems and the absence of a basal rosette of leaves at flowering time.

The calyx lobes of *Gentianella nephostelium* are unusually wide for the genus, both absolutely and in proportion to their length. White corollas with blue-violet or purple venation near the base occur in many Andean species of *Gentianella*, but in no other species do such corollas occur in combination with the tall, stout-stemmed habit of *G. nephostelium*.

4. Gentianella yanachagensis J. S. Pringle, sp. nov. TYPE: Peru. Pasco: Prov. Oxapampa, Distr. Huancabamba, Santa Bárbara, 1 km al E de la Escuela–Zona de amortiguamente, Parque Nacional Yanachaga–Chemillén, 10°21′48″S, 075°39′42″W, 29 Jan. 2005, *E. Ortíz V., F. Mellado N., A. Monteagudo M. & R. Francis J. 249* (holotype, MO!; isotypes, HAM!, HOXA images!, HUSA not seen, USM not seen). Figure 4.

Herba verosimiliter gynomonoecia, quae a congeneris caulibus repentibus, foliis caulinis majoribus oblongis usque lanceolatis, brevipetiolatis, floribus in thyrsos paucifloros dispositis, calycis lobis anguste triangularibus tubo plerumque 1.1–1.5-plo longioribus, corolla lilacina vel alba 8–16 mm longa, quam calyce 1–1.5-plo longiore et corollae lobis ovato-triangularibus tubum longitudine circum aequantibus distinguitur.

Herbs, perennial, gynomonoecious or perhaps sometimes synoecious (the limited material available for examination appeared to be gynomonoecious, except that on what appeared to be relatively small plants all flowers were bisexual). Stems glabrous; primary stems to ca. 1.5 m (*Ortíz V. et al. 249*, in sched.), firm but not stiff or woody, proximally prostrate and sinuous, 2–2.5 mm diam., with numerous slender adventitious roots; mid-cauline and distal internodes of primary stem mostly 4–6 cm, gradually shorter toward summit; widely divergent branches arising from most mid-cauline and distal nodes, generally with 1 branch per node, branches much more slender, 3.5–20 cm, longer branches occasionally with secondary branchlets; internodes of branches 4–15 mm. Leaves opposite, dark green, thin-textured, larger leaves with the proximal 1–6 mm narrowed and petiolar, 0.7–1 mm wide, distally gradually expanding into a narrowly oblong to lanceolate blade, smaller leaves sessile; leaves on primary stem 15–35 × 3–6 mm, mostly withered at flowering time, rameal leaves 9–30 × 2–5 mm; 3 or 5 primary veins distinct proximally in the larger leaves, all but the midvein breaking up into a reticulum near the middle of the leaf; bases not connate-sheathing, margins smooth, apices obtuse to acute. Inflorescence a diffuse thyrse comprising cymules that terminate the branches and branchlets, terminal cymules usually of 3 flowers, axillary cymules and those terminating branchlets comprising 1 to 3 flowers; lateral flowers and flowers on proximal branchlets smaller and later than central terminal flower; flowers ± erect, on pedicels 2–10 mm, pentamerous; bisexual (larger) flowers with calyx 6–15 mm, midveins and commissural veins suffused with purple, raised their whole length and narrowly keeled near base, tube narrowly campanulate, 3–5 mm, 3–4 mm wide at the summit, lobes all similar, narrowly triangular to narrowly oblong or nearly linear, 4–13 mm, 0.8–1.1 mm wide at the base, 1.1 to 3(to 4) times as long as the tube, distally ± spreading or recurved, margins smooth, apices acuminate, adaxial colleters present near the base of the tube but not numerous or conspicuous;

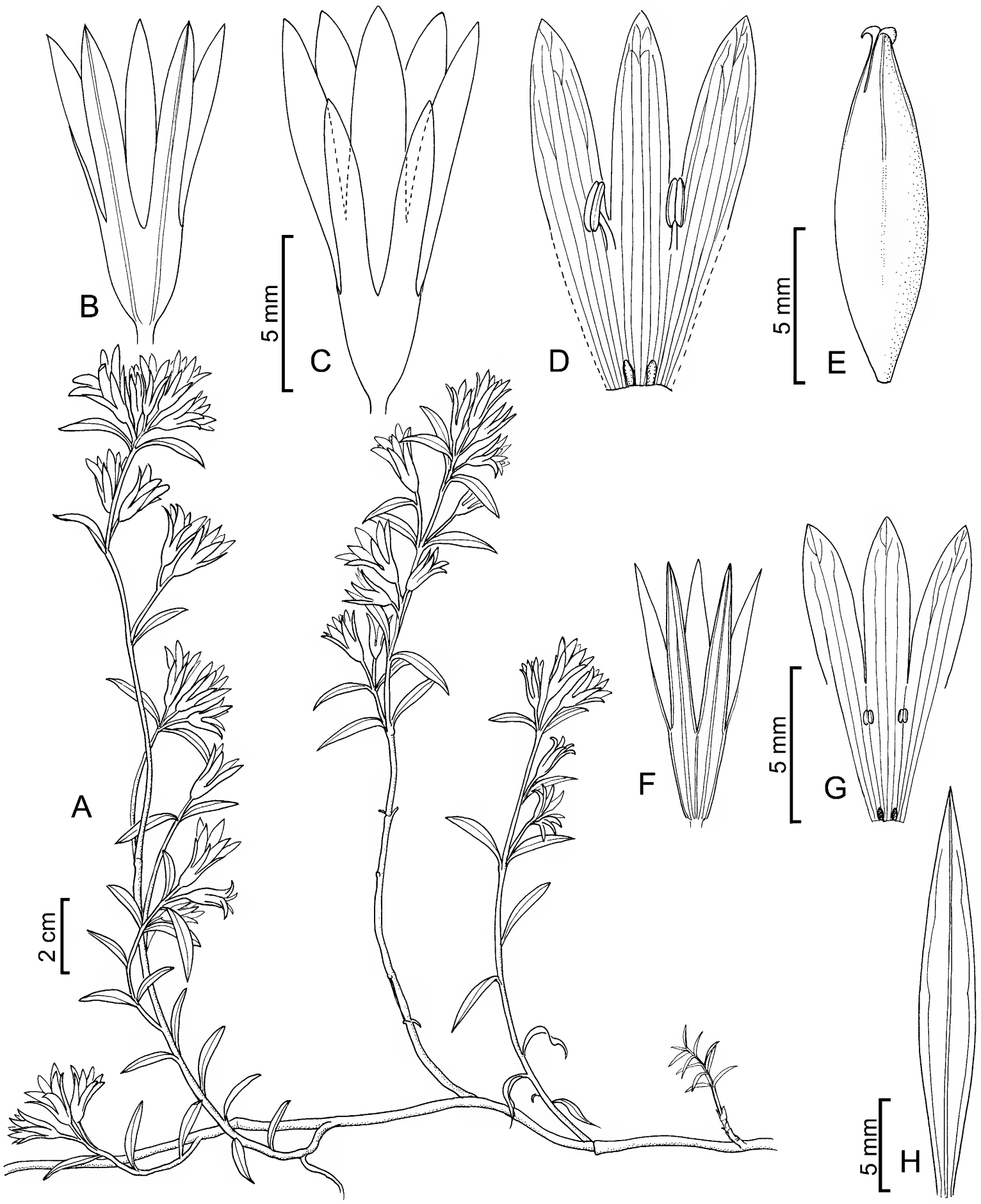

Figure 4. *Gentianella yanachagensis* J. S. Pringle. A–E. Bisexual flower. —A. Plant. —B. Calyx. —C. Perianth. —D. Adaxial view of corolla, with functional stamens and nectaries. —E. Pistil. F, G. Unisexually pistillate flower. —F. Calyx. —G. Adaxial view of corolla, with sterile stamens. —H. Leaf of primary stem. B–E to same 5-mm scale; F, G to same 5-mm scale. Drawn from *Ortíz V. et al. 249* (HAM, HOXA, MO).

corolla white to pale violet, darker violet along primary veins, 8–16 mm, 0.9 to 1.5 times as long as calyx, tube obconic, 4–7 mm, 3.5–5 mm diam. at the summit, lobes ovate-triangular, 4–8 mm, 2–2.6 mm wide at the base, 0.8 to 1.1 times as long as the tube, entire or slightly erose at the apex, adaxial trichomes absent; stamens inserted less than ca. 1 mm below the corolla sinuses, filaments 1–1.5 mm, anthers 1.2–1.5 mm, blue-violet; nectaries 5, ca. 0.8 mm; pistil green with whitish stigma, ovary sessile at anthesis; unisexually pistillate flowers similar but generally smaller in all parts, with sessile anthers ca. 0.4 mm, with empty pollen sacs, inserted at ca. 0.6 times the height of the corolla tube. Capsule medium brown, stipe scarcely

developing in fruit. Seeds golden brown, nearly spherical, ca. 0.6 mm diam., surface nearly smooth.

Habitat, distribution, and phenology. *Gentianella yanachagensis* is known only from the type locality in Yanachaga–Chemillén National Park, in Pasco Department, central Peru. Its habitat at that site was an ecotone between the upper limit of the montane forest and a high-altitude grassland (pajonal de puna) at 3390–3420 m (*Ortíz V. et al. 249*, in sched., isotype at HOXA). Both flowers and fruits were present when the type specimens were collected in January. Yanachaga–Chemillén National Park encompasses an isolated mountain chain east of the main Andean cordillera, notable for its diversity of species. Several new endemic species of flowering plants as well as amphibians and lizards have been described from this biogeographic "island" in recent years (Lehr et al., 2007, 2012; Venegas et al., 2011).

Etymology. *Gentianella yanachagensis* is named for the type locality, to call increased attention to the biological diversity and endemic species in the Yanachaga–Chemillén National Park and thereby to encourage concern for the preservation of that biodiversity.

Discussion. In *Gentianella yanachagensis*, as in some other species in the Swertiinae, the lateral or all flowers in the cymules on the proximal branches may be smaller and unisexual. Whereas in other species such reduced flowers are usually staminate, those examined in *G. yanachagensis* were pistillate. Figure 4G shows a flower in which the stamens were vestigial, consisting of sessile anthers ca. 0.4 mm with nonfunctional pollen sacs, inserted at ca. 0.6 times the height of the corolla tube. The fruit and ovules had been developing normally. The larger flowers on all stems examined in this study were bisexual, with the stamens normally developed. Since reduced flowers appear to be proportionately more numerous in *G. yanachagensis* than in most species of *Gentianella*, this species should probably be regarded as being at least borderline gynomonoecious, but because of the limited material available for this study, further observations of floral heteromorphy in *G. yanachagensis* would be desirable.

No one previously known species of *Gentianella* is clearly the most similar to *G. yanachagensis*. *Gentianella yanachagensis* does not closely resemble any of the five species described by Filippa and Barboza (2006) as gynomonoecious, all of which are native to Argentina, with at least one also occurring in Bolivia. In none of those species are the stems trailing or vinelike. In *G. imberbis* (Griseb.) Filippa & Barboza and *G. multiflora* (Griseb.) Fabris the inflorescences are much denser than those of *G. yanachagensis*, and the corolla lobes are ovate to obovate. In *G. fabrisii* Filippa & Barboza, *G. kurtzii* (Gilg) Fabris, and *G. myriantha* (Gilg) Holub the corolla lobes are much longer than the tube.

Although some other South American species of *Gentianella* have decumbent stems, *G. yanachagensis* represents an extreme in this respect. In habit it is perhaps most closely approached by *G. decemnectaria*, of northern Peru, which differs from *G. yanachagensis* in its proportionately wider leaves, connate-sheathing leaf bases, corollas 16–22 mm when closed and nearly rotate when fully expanded, and rhombic to obovate corolla lobes. Uniquely in the genus, the many short, slender branches of *G. yanachagensis* bear small, closely spaced leaves that diverge from the stem at approximately 90°, so that in herbarium specimens a short branch resembles a vetch leaf.

The slender, petiolar proximal portion of the larger leaves of *Gentianella yanachagensis* is unusual in *Gentianella*. The leaves of this species, including the narrowed proximal portion, spread from the stem at the point of attachment, thus differing from the leaves of such species as *G. grantii* J. S. Pringle, of southern Peru (described in Pringle & Grant, 2012), and *G. hypericoides* (Gilg) Fabris, of southern Ecuador, which consist of a narrowed, appressed or strongly ascending proximal portion and an abruptly differentiated, wider, spreading distal portion. Another unusual feature of *G. yanachagensis* is the proportionate lengths of the calyx and corolla, with the calyx nearly as long as the corolla or, on the smaller flowers, equaling or slightly exceeding it. Yet another unusual feature is the shape of the corolla lobes, like a lancet window in Gothic architecture, i.e., parallel-sided for much of their length, distally curving convexly to an acute apex. In most of the other South American species of *Gentianella* the corolla lobes range from lanceolate or ovate to oblanceolate or obovate, distinctly wider distally than at the base.

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Carex socotrana, a New Endemic Species from Socotra Island

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Abstract. We describe *Carex socotrana* Řepka & Maděra, a new endemic species found in the Hajhir Mountains on Socotra Island. It differs from the morphologically similar African continental species *C. steudneri* Boeckeler in having a shorter stem, smaller leaf length and width, completely smooth leaf blades and margins, and pistillate scales without a whitish membranous margin and with distinctive awns at the apex. The spike clusters are smaller and more scattered on the stem, and the perigynium and its beak are smaller than in *C. steudneri*. So far only one small and one large population have been found near the highest mountain peak, Mount Scand. The new taxon is 1370 km from the closest known site of *C. steudneri*.

Key words: *Carex*, Cyperaceae, IUCN, Socotra.

Island endemism has been a well-known phenomenon since the mid-19th century (Darwin, 1859), and on some islands, depending in part upon their age, a high proportion of local species are endemic (Carlquist, 1974; Whittaker & Fernández-Palacios, 2007). Socotra Island is relatively old, about 17–20 million years (Culek, 2013), with geological and phytogeographical relations to the Horn of Africa as well as to Yemen or the Arabian Peninsula. The Socotra Archipelago has a rich vascular plant flora. Brown and Mies (2012) recorded 842 species, of which 309 are endemics, which is 36.7% of the total island flora. This fact puts Socotra endemism at the forefront among small islands, as a higher degree of endemism has only been recorded in the Hawaiian Islands (90%), Juan Fernandez Island (80%), Ascension Island (44%), and the Galapágos Archipelago (42%) (Cheung & DeVantier, 2006).

A total of 27 species of Cyperaceae were recorded from Socotra by Vanderschaeve (2001), but no representatives of the genus *Carex* L. were among them. Miller and Morris (2004) mention two *Carex* specimens collected by A. G. Miller in the western part of the Hajhir Mountains, whose populations can currently not be relocated, representing the only potential records of this genus from Socotra. These two specimens are not currently available.

In the years 2013 to 2014, as part of research activities on Socotra, a small sedge population belonging to a different species was found in the same region by the second author. In the autumn of 2016, our colleague S. Lvoncik found a large population about 1 km from the first locality. These populations can be identified as *Carex* subg. *Vigneastra* (Tuck.) Kük. based on androgynous spikes, structure of inflorescence, and considerable similarities of perigynia with representatives of the continental members of this subgenus.

The overview of Cyperaceae for the *Flora of the Arabian Peninsula and Socotra* (MacKinnon & Simpson, 2017) is not yet available for identification of these populations. However, sedge accounts are published in the floras of Ethiopia (Lye, 1997) and Somalia (Lye, 1995), and for the sub-Saharan part of Africa (Gehrke, 2011). This part of the world is poor in *Carex* species diversity. Gehrke (2011) reported 81 species and six infraspecific taxa from sub-Saharan Africa and Madagascar, of which 17 species belong to subgenus *Vigneastra*. The flora of Somalia contains only two species (Lye, 1995), and 19 *Carex* species have been reported for the flora of Ethiopia (Lye, 1997), four of them belonging to subgenus *Vigneastra*. *Carex steudneri* Boeckeler, representative of this subgenus and growing in six regions of Ethiopia, in Kenya (Cherangani Hills), southern Tanzania, Malawi, and Zimbabwe (Gehrke, 2011), is most similar to our discovery in morphological features (Table 1). However, our plants differ markedly from this species, mainly in the size of the vegetative parts and in some significant reproductive characters, and are therefore described below as a new species.

Carex socotrana Řepka & Maděra, sp. nov. TYPE: Yemen. Soqotra [Socotra] Island: Haggeher [Hajhir] Mtns., on intermittently dripping rocks along cattle trails, upper part of the ridge in SWW–NEE direction to Mt. Scand, 700 m WSW of the settlement of Momheir, 12°34′24″N, 54°01′12″E, 1400 m, 25 Nov. 2014, *P. Maděra s.n.* (holotype, E-00742649!). Figure 1.

Table 1. Comparison of characters distinguishing *Carex socotrana* Řepka & Maděra and *C. steudneri* Boeckeler.

	C. socotrana	*C. steudneri*[1]
Stem length	40–45 cm	40–70 cm
Stem diam. in middle part	1–1.5 mm	1.5–2.5 mm
Leaf blade size	16–22 cm × 4.5–5 mm	5–30 cm × 3–12 mm
Leaf blade shape in cross-section	slightly canaliculate	flat
Leaf blade texture	smooth on margin and surface	strongly scabrid
Spike size and shape	8–16 × 1.5–2.5 mm, lanceolate to ovate-lanceolate	6–15 × 1–2 mm, lanceolate
Spike clusters	17–25 mm, more scattered	28–78 mm, merged or scattered
Pistillate scale length	(3.9–)5.2–6.6(–7.2) mm, with an awn (1–)1.4–2.6(–2.8) mm (to 4 mm in lower part of spike)	3–6 mm (upper always 5–6 mm), without an awn
Pistillate scale color	light brownish or rusty brownish to straw-colored, without a central stripe or whitish membranous margin	medium red-brown, with a pale brown midrib and whitish membranous margin apically
Perigynium length	(4.5–)5–5.8(–6.7) mm	(5.1–)5.6–7.2(–8) mm
Perigynium beak length	1.7–2.5 mm	(1.8–)2.1–2.8(–3.5) mm
Perigynium indumentum	shortly hairy on adaxial side, in upper part, and on beak	densely scabrid at least on beak and major nerves

[1] From Lye (1997) and our own observations.

Diagnosis. *Carex socotrana* Řepka & Maděra differs from *C. steudneri* Boeckeler in having shorter stems, smaller leaves with a slightly canaliculate rather than flat shape in cross section, completely smooth leaf blades and margins, pistillate scales lacking a whitish membranous margin and with distinctive apical awns, smaller and more scattered spike clusters, and a smaller perigynium (Fig. 2).

Plants tufted with hard woody rhizome, covered with dark brown fibers from disintegrating leaf sheaths; shoots noticeably tuberous and thickened at the base. Roots very stiff, hard, dark gray, 1–1.7 mm diam. Lower leaf sheaths moderately dark brown, dull, disintegrating into brown fibers or narrow segments. Stems straight, slightly pendulous when in flower and fruit, 40–45 cm, obtusely trigonous, smooth, up to 1.5 mm wide, 1 mm below the inflorescence, uppermost leaf inserted in lower 1/10. Leaves at perigynium maturity shorter than stems, slightly canaliculate, gray-green to dark green, dull, smooth on margin and surface, revolute after drying; leaves of sterile shoots 16–22 cm × 4.5–5 mm; lower stem leaves short, with short sheath and 15-cm-long blade. Inflorescence slightly pendulous, rarely straight, 28–30 cm, narrowly paniculiform with 3 to 6 spike clusters 17–25 mm, separate and slightly remote, in upper part of inflorescence overlapping, spikes 9 to 35 in total; tubular cladoprophylls located on base of secondary branches of inflorescences, ca. 2 mm, brownish; lowermost branches with peduncle 50–85 mm, up to 10 cm from the rest of inflorescence. Lowermost bract 10–15 cm, leaflike, longer than subtended spike cluster, its sheath 9–26 mm. Scales in lower part of spike gradually passing into bristlelike bracts. All bracts shorter than inflorescence. Spikes androgynous, lanceolate to ovate-lanceolate at maturity, 8–16 × 1.5–2.5 mm, lower ones pedunculate or sessile, upper ones sessile. Pistillate scales elliptical to lanceolate-elliptical, longer and slightly wider than perigynium, (3.9–)5.2–6.6(–7.2) × 0.8–1 mm, light brownish or rusty brownish to straw-colored, without central stripe or whitish membranous margin; apex mucronate to awned, awn (1–)1.4–2.6(–2.8) mm, in lower part of spike up to 4 mm. Staminate scales narrowly lanceolate or linear, 3.8–4.3 × 0.4–0.5 mm, light brown, with awn 1–1.5 mm. Anthers 2–3.2 mm. Stigmas 3. Perigynia elliptical to lanceolate-elliptical in outline, strongly convex on abaxial side, flat on adaxial side, substipitate or sessile, with a stalk 0.2–0.3 mm, (4.5–)5–5.8(–6.7) × (1.1–)1.2–1.4(–1.7) mm, gradually tapering into a 1.7- to 2.5-mm beak with spinelike papillae on margin, at the top with 0.4- to 1-mm-long, sharp, ivory teeth, adaxial surface of apical part and beak covered (sometimes densely) with 0.1-mm hairs, prominently veined abaxially, usually veinless adaxially, brown (maroon) to light brown. Achenes narrowly spindle-shaped, trigonous, brownish gray, 2.9–3.3 × 0.9 mm, with the style base tubular, 0.2–0.3 mm.

Distribution and ecology. *Carex socotrana* has to date been found in two locations on Socotra Island: on the southern slopes of the highest part of the Hajhir Mountains, between the peaks Mount Scand and Mount

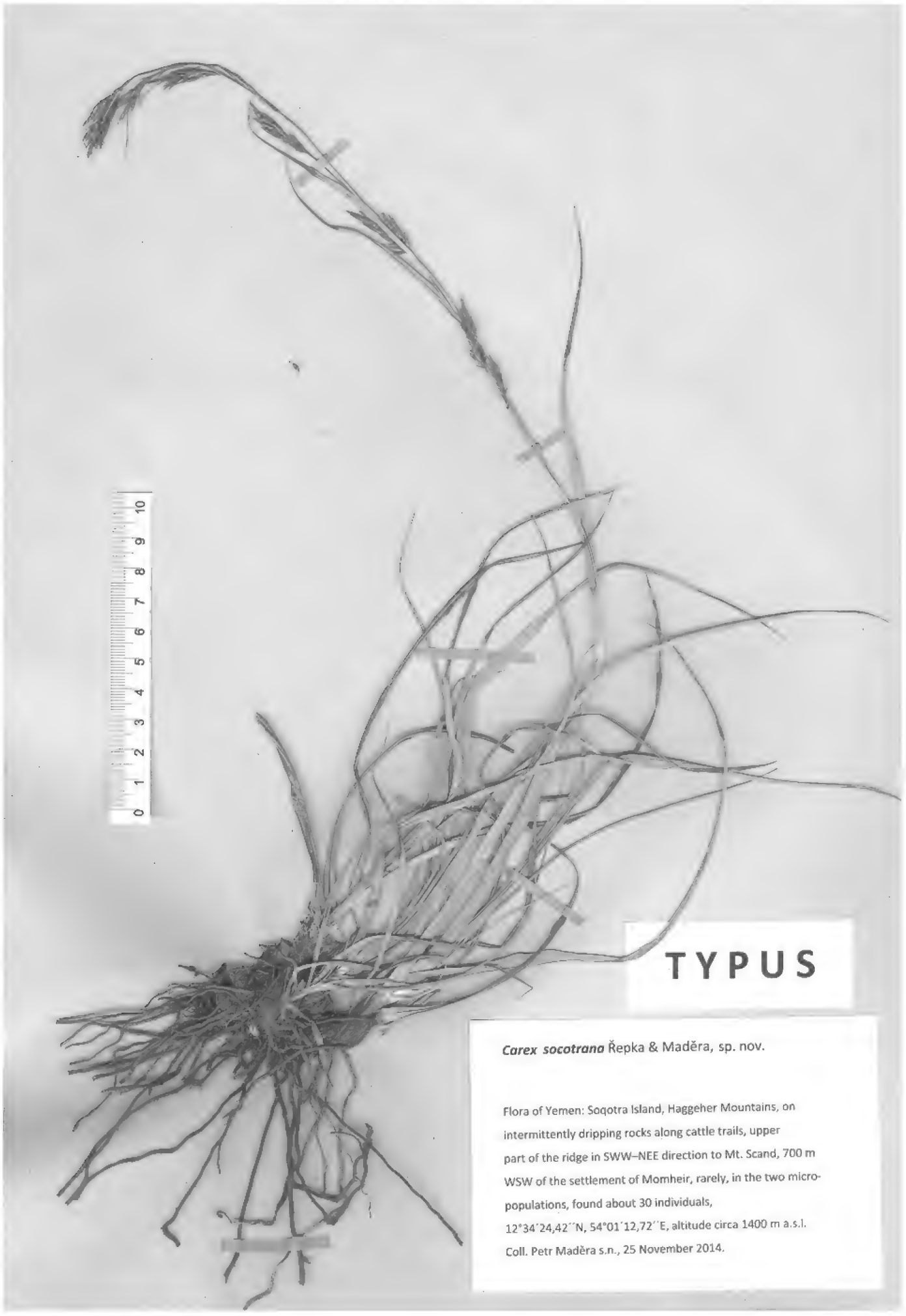
TYPUS
Carex socotrana Řepka & Maděra, sp. nov.
Flora of Yemen: Soqotra Island, Haggeher Mountains, on intermittently dripping rocks along cattle trails, upper part of the ridge in SWW–NEE direction to Mt. Scand, 700 m WSW of the settlement of Momheir, rarely, in the two micro-populations, found about 30 individuals, 12°34´24,42´´N, 54°01´12,72´´E, altitude circa 1400 m a.s.l.
Coll. Petr Maděra s.n., 25 November 2014.

Figure 1. Type specimen of *Carex socotrana* Řepka & Maděra (*P. Maděra s.n.*, E-00742649).

Mashanig, and along cattle trails in hilly terrain on the southern slope of Mount Scand. This is the windward side of the mountains, which receives plenty of rainfall during the summer (and winter) monsoon. In the first locality, a relatively larger population grows on the southern slopes of the Hajhir Mountain ridge, scattered in appropriately moist habitats, e.g., in damp, rocky crevices and seeps with shallow substrate covered with mosses, over about 3 km. Hundreds of fertile individuals were observed. The second site is about a 15-minute walk from the top of the mountain; the plant grows on intermittently dripping rocks (from fog and rain) with an

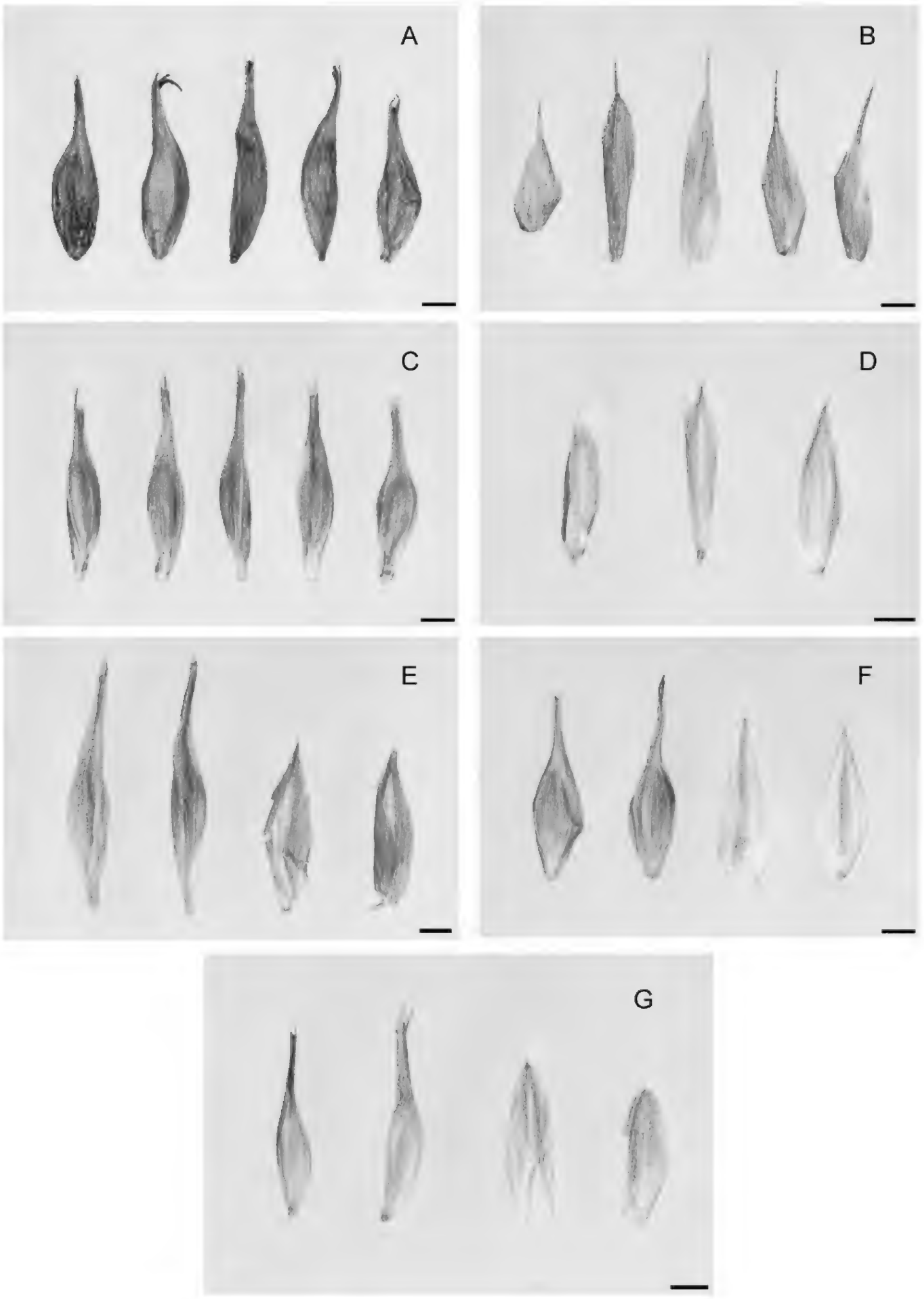

Figure 2. A, B. *Carex socotrana* Řepka & Maděra (holotype, *P. Maděra s.n.*, E-00742649). —A. Perigynia. —B. Pistillate scales. C–G. *Carex steudneri* Boeckeler. —C. Perigynia of *J. Raynal 8170* (K). —D. Pistillate scales of s. coll. *H 21* (K). —E. Perigynia and pistillate scales of *M. W. Schimper 949* (K). —F. Perigynia and pistillate scales of *H. F. Mooney 5563* (K). —G. Perigynia and pistillate scales of *J. J. F. E. De Wilde 5060* (K). Scale bar = 1 mm. Photos by M. Čermák.

eastern exposure, in places with cracks and on a terrace with a very shallow soil cover and open vegetation. In this locality, it was found in two close micro-populations (18 and 13 individuals), with individuals in various stages of development, from young small clumps up to adult fruiting tufts (observed in eight individuals).

Other vascular plants growing with the sedge include: *Achyranthes aspera* L. (Amaranthaceae), *Adiantum*

balfourii Baker (Pteridaceae), *Anagallis arvensis* L. (Primulaceae), *Asplenium aethiopicum* (Burm. f.) Bech. (Aspleniaceae), *Begonia socotrana* Hook. f. (Begoniaceae), *Croton sulcifructus* Balf. f. (Euphorbiaceae), *Cryptolepis socotrana* (Balf. f.) Venter (Apocynaceae), *Dioscorea lanata* Balf. f. (Dioscoreaceae), juvenile *Dracaena cinnabari* Balf. f. (Asparagaceae), *Geranium biuncinatum* Kokwaro (Geraniaceae), *Habenaria socotrana* Balf. f. (Orchidaceae), *Haya obovata* Balf. f. (Caryophyllaceae), *Helichrysum rosulatum* Oliv. & Hiern, *Helichrysum* sp. B, and *Pulicaria lanata* E. Gamal-Eldin (Asteraceae), *Hypericum scopulorum* Balf. f. (Hypericaceae), *Micromeria remota* Balf. f. (Lamiaceae), *Oldenlandia balfourii* Bremek. (Rubiaceae), *Searsia thyrsiflora* (Balf. f.) Moffett (Anacardiaceae), and *Tamridaea capsulifera* (Balf. f.) Thulin & B. Bremer (Rubiaceae).

IUCN Red List category. Only two populations of this endemic species, growing close to each other, are known to date. Following IUCN Red List criteria and categories (IUCN, 2012) we evaluate the conservation status of *Carex socotrana* as Vulnerable [VU D1+2].

Discussion. Based on a brief remark by Vanderschaeve (2001), it is possible that this new species may also be found in the western part of the Socotrean Hajhir Mountains. This possibility deserves further research. Lye (1997: 511) reported another, yet undescribed species labeled "*Carex* sp." (*Mulvany 120*, K), morphologically close to *C. steudneri* s. str., growing in mountain grasslands at an altitude of ca. 3000 m in the Ethiopian region of Gojan. We studied this specimen and found it to differ from the type of *C. socotrana* by darker scales and larger and less numerous spike clusters; it falls within the range of variation of *C. steudneri* and does not pertain to our new species.

Based on studied herbarium material (at K and E; see Appendix 1), inflorescence characters of *Carex steudneri* are very variable. We studied morphotypes whose lower clusters have very long peduncles, whereas some have smaller clusters scattered throughout the inflorescence, or in contrast have inflorescences with a very compact and long upper part with just two to three separated clusters in the lower part. The color of the spikes is very variable, in some specimens greenish brown but in most brown in a variety of shades. Figure 2 shows variability in shape of the perigynia, pistillate scales, and their tip. The perigynia (the most important feature in *Carex*) of both species, *C. steudneri* and *C. socotrana*, are similar in shape and size (see Fig. 2). We conclude that *C. socotrana* differs mainly in quantitative characters, but also has a few qualitative characters that distinguish it significantly from *C. steudneri*. Additionally, *C. socotrana* is geographically isolated from the nearest localities of the related *C. steudneri* (1370 km away in Ethiopia) and other species of the subgenus.

According to preliminary results of molecular analyses of the plastid *trnL-trnF* and nuclear ITS of rDNA, *Carex socotrana* falls in a clade composed of members of subgenus *Vigneastra* and is closely related to *C. steudneri* (A. Forrest & P. Madera, unpublished data). Resolution among species in this subgenus is low, and further analyses are required before species-level relationships among taxa in this subgenus can be determined.

Paratype. YEMEN. **Socotra Island:** Hajhir Mtns., S slopes of the highest parts of the main ridge betw. the peaks Scand & Mashanig, 24 Oct. 2016, *S. Lvoncik s.n.* (BRNL).

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Appendix 1. Additional specimens studied for comparison (*Carex steudneri* Boeckeler).

ETHIOPIA. Mt. Entotto, *J. Raynal 8170* (K); Mt. Silke, *M. W. Schimper 949* (K); Mega, Sidamo, *H. F. Mooney 5563* (K); Gara Mullata, *J. J. F. E. De Wilde 5060* (K); Dire Dawa, s. coll. *H 21* (K); Dambo, *P. M. Mulvany 120* (K); Mt. Delo, *J. B. Gillett 14906* (K); Mt. Amora, *C. L. A. Leakey 632* (K); Amhara-Semien, *G. Chiovenda 3116* (K); Bale Mtns. Natl. Park, *O. Hedberg 5686* (K); Mt. Abbak, *C. L. A. Leakey & I. M. Evans 547* (K); Ex Tigrè V. Begemder, *G. W. Schimper 1559* (E). SUDAN. Kipia, *J. K. Jackson 1528B* (K); Mt. Kineti, *J. G. Meyers 11638* (K).

Phaleria stevensiana: A Distinctive New Species of Thymelaeaceae Endemic to Sulawesi, Indonesia

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Abstract. An undescribed species of *Phaleria* Jack from Sulawesi has been uncovered during ongoing herbarium studies of Thymelaeaceae and is still only known from the type. The species, *P. stevensiana* Z. S. Rogers, is endemic to a single limestone mountain in South Sulawesi and assigned a preliminary IUCN conservation status of Critically Endangered (CR). Morphologically, it is easily distinguished from the widespread *P. octandra* (L.) Baill. and *P. capitata* Jack by its linear-lanceolate leaves (length:width ratios ca. 11–20:1) and distinctive venation pattern, composed of ca. 29 to 35 pairs of secondary veins that diverge from the midrib of the blade at ± 90° angles; the contrasted species have much broader leaves with substantially fewer secondaries. Variation in other characters related to inflorescences, flowers, and fruits is also discussed, as is their taxonomic value. Moreover, all four species of *Phaleria* occurring in Sulawesi are allopatric, separated geographically and ecologically. The new species, overlooked in several herbaria since 1980, raises the number of Sulawesian Thymelaeaceae species to 10 and the total number of *Phaleria* species to ca. 25.

Key words: Celebes, Indonesia, IUCN Red List, *Phaleria*, Sulawesi, Thymelaeaceae, Thymelaeoideae.

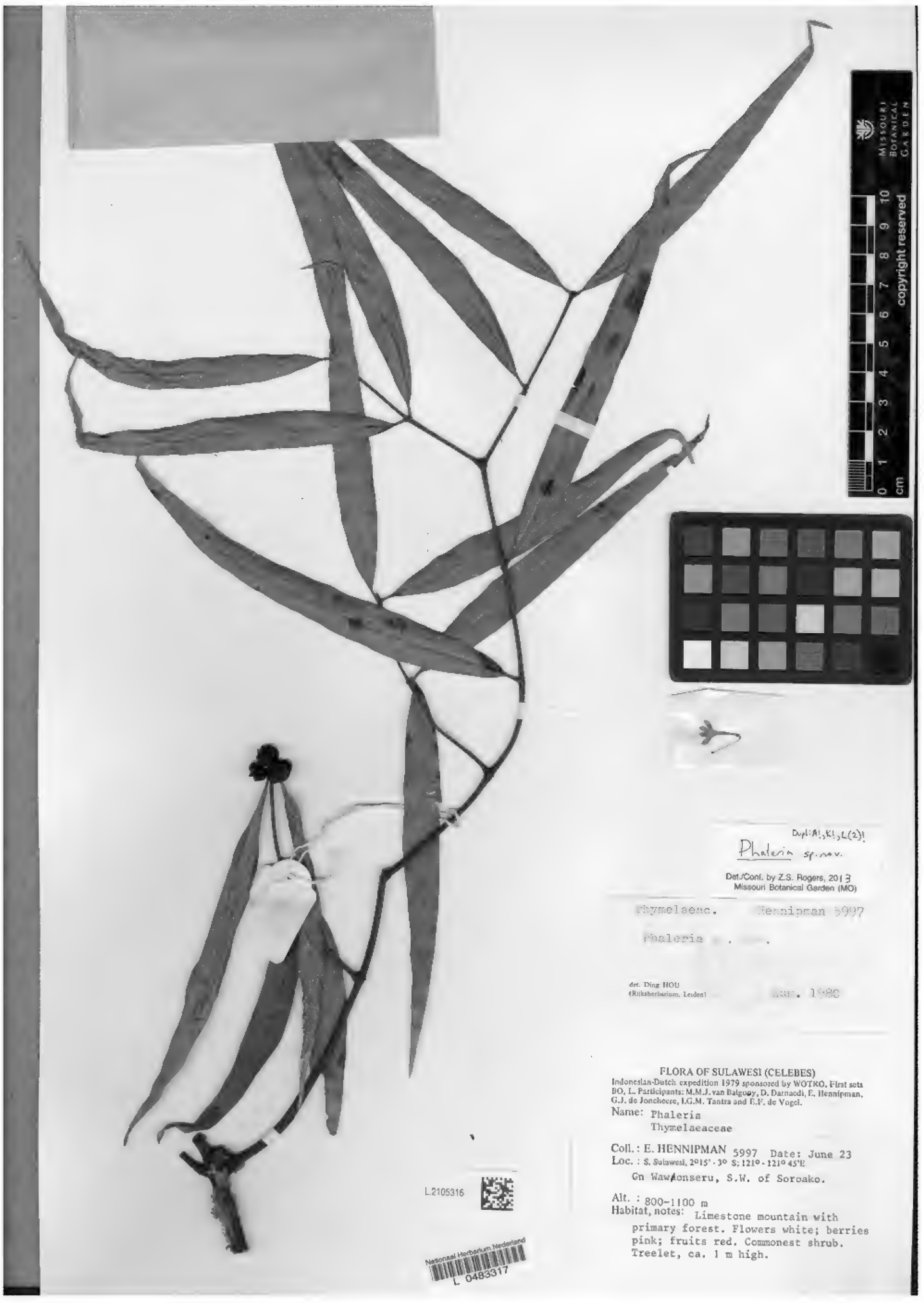
Sulawesi, the 11th largest island in the world (ca. 182,000 km² land area), is the largest terrestrial member of the Wallacea biodiversity hotspot and renowned for high rates of endemism, particularly faunal, which makes it one of the most important conservation priorities on Earth (Myers et al., 2000). The island is so biologically diverse because of a number of unique geographic and historical factors, such as its role as a biogeographic crossroads between East Asia and Australasia; its complex geology, which includes some of the largest mafic outcrops in the world; its relatively long isolation through the Quaternary Period from the Sunda Shelf Islands; and its unusual shape formed by four narrow peninsulas radiating out from a small central core, which yields an incredibly long coastline for its size and constrains the land mass so that every point on the island lies within 100 km of the coast (Whitten et al., 2002; Cannon et al., 2007). Clearly, more recent population migrations and longer radiations have proven slow, difficult, and in some cases totally impossible.

Besides its high levels of biodiversity and endemism, Sulawesi is the most poorly known botanically of the over 17,000 islands comprising Indonesia, with an average collection density of only ca. 20 specimens per 100 km², about 10 times lower than the density estimated for Java (Prance, 1977; Whitten et al., 2002). Insufficient and uneven plant collecting efforts on the island (Cannon et al., 2007) demonstrate large gaps in our plant knowledge, and it is clear that there are still large swaths of unexplored land, especially in areas with the most interesting vegetation, namely forests on limestone and ultramafic (ultrabasic) substrates. These distinct substrates and their quite different floras are confined mostly to the southern half of the island, particularly common to the Southeast and East Peninsulas (Balgooy & Tantra, 1986). Because these areas have nutrient-poor soils, their primary vegetation is being degraded by agriculture and logging more slowly compared to other vegetation types occurring elsewhere on Sulawesi. To illustrate the uniqueness and threatened nature of the Sulawesian flora while highlighting our incomplete knowledge of it, we must look no further for an example than the new species described here, an apparently locally common threatened species endemic to the forested limestone mountain of Mount Wawonseru, and still only once collected in 1979 in an area that is one of the better-surveyed regions of the island.

"Rediscovering" the New Species

As part of my ongoing taxonomic studies of Thymelaeaceae worldwide, a distinctive undescribed species of *Phaleria* Jack came to my attention based on a herbarium examination of *Hennipman 5997* (A, BO-1943815, K, L 0483317, L 0483318). The collection, which is composed of ample flowering and fruiting material, was gathered from South Sulawesi during the joint botanical expedition of the Indonesian Institute of Science (LIPI) and the Nationaal Herbarium

Nederland in 1979 that was financed by the Dutch Organisation for Scientific Research in the Tropics (WOTRO, a division of the Netherlands Organisation for Scientific Research, NWO) (Balgooy & Tantra, 1986; Hennipman & Verduyn, 1987). In August 1980, Ding Hou, the author of the Thymelaeaceae treatment for *Flora Malesiana* (Ding Hou, 1960), annotated one of the two L sheets (L 0483317; Fig. 1) as a new species without suggesting an epithet. The new species was never named, formally or informally, but was cited as an unidentified *Phaleria* collection in the most recent checklist of Sulawesian woody plants (Kessler et al., 2002). The


MISSOURI BOTANICAL GARDEN
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cm 0 1 2 3 4 5 6 7 8 9 10
Dupl: A!, K!, L(2)!
Phaleria sp. nov.
Det./Conf. by Z.S. Rogers, 2013
Missouri Botanical Garden (MO)
Thymelaeac. Hennipman 5997
Phaleria
det. Ding HOU
(Rijksherbarium, Leiden)
FLORA OF SULAWESI (CELEBES)
Indonesian-Dutch expedition 1979 sponsored by WOTRO. First sets BO, L. Participants: M.M.J. van Balgooy, D. Darnaedi, E. Hennipman, G.J. de Jonckheere, I.G.M. Tantra and E.F. de Vogel.
Name: Phaleria
Thymelaeaceae
Coll.: E. HENNIPMAN 5997 Date: June 23
Loc.: S. Sulawesi, 2°15'-3° S; 121°-121° 45'E
Gn Wawonseru, S.W. of Soroako.
Alt.: 800-1100 m
Habitat, notes: Limestone mountain with primary forest. Flowers white; berries pink; fruits red. Commonest shrub. Treelet, ca. 1 m high.
L2105316
National Herbarium Nederland
L 0483317

Figure 1. *Phaleria stevensiana* Z. S. Rogers (holotype, *E. Hennipman 5997*, L 0483317).

Hennipman collection escaped further scrutiny until 2008, when a then-unidentified duplicate, composed of a branch with loose flowers, surfaced during my visit to the Royal Botanic Gardens, Kew. An examination of a second duplicate in flower bud at Harvard in 2013 prompted a request for digital images of duplicates at L in search of the red fruits described on the labels that were absent from the sheets already examined at A and K. Luckily, sheet L 0483317, composed of flowering and fruiting material, included one dissected fruit with an obvious 2-locular gynoecium, a characteristic feature of *Phaleria* that removed any doubt that *Hennipman 5997* could have belonged to a very unusual, undescribed species of *Wikstroemia*, which has 1-locular ovaries and other technical floral differences (see Herber, 2003). For the last few years, the publication of this new species of Thymelaeaceae was delayed because the L duplicates were unavailable during the reorganization of Nationaal Herbarium Nederland. Prior to the present study, two plant checklists for Sulawesi had accounted for a total of nine species of Thymelaeaceae, including three species of *Phaleria*: *P. capitata* Jack, *P. coccinea* (Gaudich.) F. Muell., and *P. octandra* (L.) Baill. (Kalima-Sutrasno, 1989; Kessler et al., 2002). Here, I am proud to present the description of *P. stevensiana* Z. S. Rogers, named in honor of the illustrious Dr. Peter F. Stevens.

Briefly about the Genus *Phaleria*

Phaleria, an attractive widespread Indo-Pacific genus of ca. 25 species, ranges from Sri Lanka eastward to Tonga and Samoa and also occurs in Eastern Australia (Townsend, 1981; Rye, 1990; Herber, 2001; Rogers, 2009a). Centers of species diversity are Fiji (nine spp.; Smith, 1942, 1981), Papua New Guinea (ca. eight spp.; Stevens, 1974), and Australia (four spp., including the monotypic *Oreodendron* C. T. White; Herber, 2001, 2003).

Based on morphology, the genus has been placed in the informal "Phaleria group" (Thymelaeoideae), along with *Peddiea* Harv. ex Hook. (Herber, 2003), a genus comprising ca. 14 African species and a single species endemic to Madagascar (Rogers, 2009a, 2009b). *Phaleria* and *Peddiea* share 2-locular ovaries, a similar venation pattern, and indehiscent fruits. Molecular data published in three complementary studies (van der Bank et al., 2002; Beaumont et al., 2009; Motsi et al., 2010) utilizing plastid and nuclear genes failed to resolve the two genera of the "Phaleria group" as sister taxa and instead found a stronger sister relationship between accessions of the aforementioned *Phaleria capitata*, a widespread Indo-Pacific species, and the East and South African *Dais cotinifolia* L. In all three studies, *Peddiea* resolved outside of the *Phaleria-Dais* clade and fell variously into poorly supported heterogeneous clades, an ultimately weak phylogenetic backbone no doubt at least partly due to uneven, incomplete sampling across most of the Thymelaeoideae. Foster et al. (2016) has demonstrated that relationships in unresolved groups in the subfamily, such as *Pimelea* Banks ex Gaertn. and *Thecanthes* Wikstr., can be clarified with expanded sampling and additional genes. In regard to the close putative relative *Dais* L., it should be pointed out that Foster et al. (2016) stated that the genus, which was part of the outgroup, was monophyletic with strong support values; but their data (supplemental materials) cannot possibly be used to address the monophyly of the genus, as only one of the two species belonging to it was analyzed (one accession of *D. cotinifolia*). To date, the same originally sequenced accession of *Phaleria capitata* first analyzed by van der Bank et al. (2002) has been the only species of ca. 25 total species to be analyzed phylogenetically.

Morphologically speaking, *Phaleria* is distinguished from *Dais* by its 2-locular (though sometimes only 1-locular by abortion) ovary (vs. ovary always 1-locular) and its terminal (vs. lateral) style, whereas *Phaleria* differs most obviously from *Peddiea* by its opposite or rarely subopposite (vs. alternate) phyllotaxy. In regard to distribution and diversity, besides the single aforementioned African species of *Dais*, there is only one other species in the genus, the yet-to-be sequenced Malagasy endemic *D. glaucescens* Decne. (Rogers, 2009a, 2009b). Building robust gene trees with better sampling via affordable high-throughput sequencing is the next logical step to resolve relationships between *Phaleria*, *Dais*, and *Peddiea*, and will be essential to adequately address questions of monophyly and subsequent recircumscriptions of many other unresolved genera belonging to the largest subfamily, the Thymelaeoideae.

Phaleria stevensiana Z. S. Rogers, sp. nov. TYPE: Indonesia. Sulawesi: Prov. South Sulawesi, Mt. Wawonseru, SW of Soroako [Sorowako], 2°15′–3°00′S, 121°00′–121°45′E, 800–1100 m, 23 June 1979 (fl., fr.), *E. Hennipman 5997* (holotype, L [barcode] L0483317!; isotypes, A [bc] A00460927!, BO-1943815 image!, L [bc] L0483318!, K!). Figures 1, 2.

Diagnosis. *Phaleria stevensiana* Z. S. Rogers is distinguished from *P. octandra* (L.) Baill. and *P. capitata* Jack by its linear-lanceolate leaves (length:width ratios 11–20:1 vs. ca. 2.5–5[–7]:1), and distinctive venation pattern composed of ca. 29 to 35 pairs of secondary veins that diverge from the midrib at ± 90° angles (vs. ca. 7 to 13 pairs diverging at more acute angles).

Treelet or shrub, ca. 1 m tall. Taproot with ca. 10 rootlets, those unbranched, fibrous, similar to branches except thinner. Branches with internodes ca. 1.2–3.6 cm. Stems longitudinally striate, glabrescent or irregularly sparsely puberulent, older stems transversely cracked,

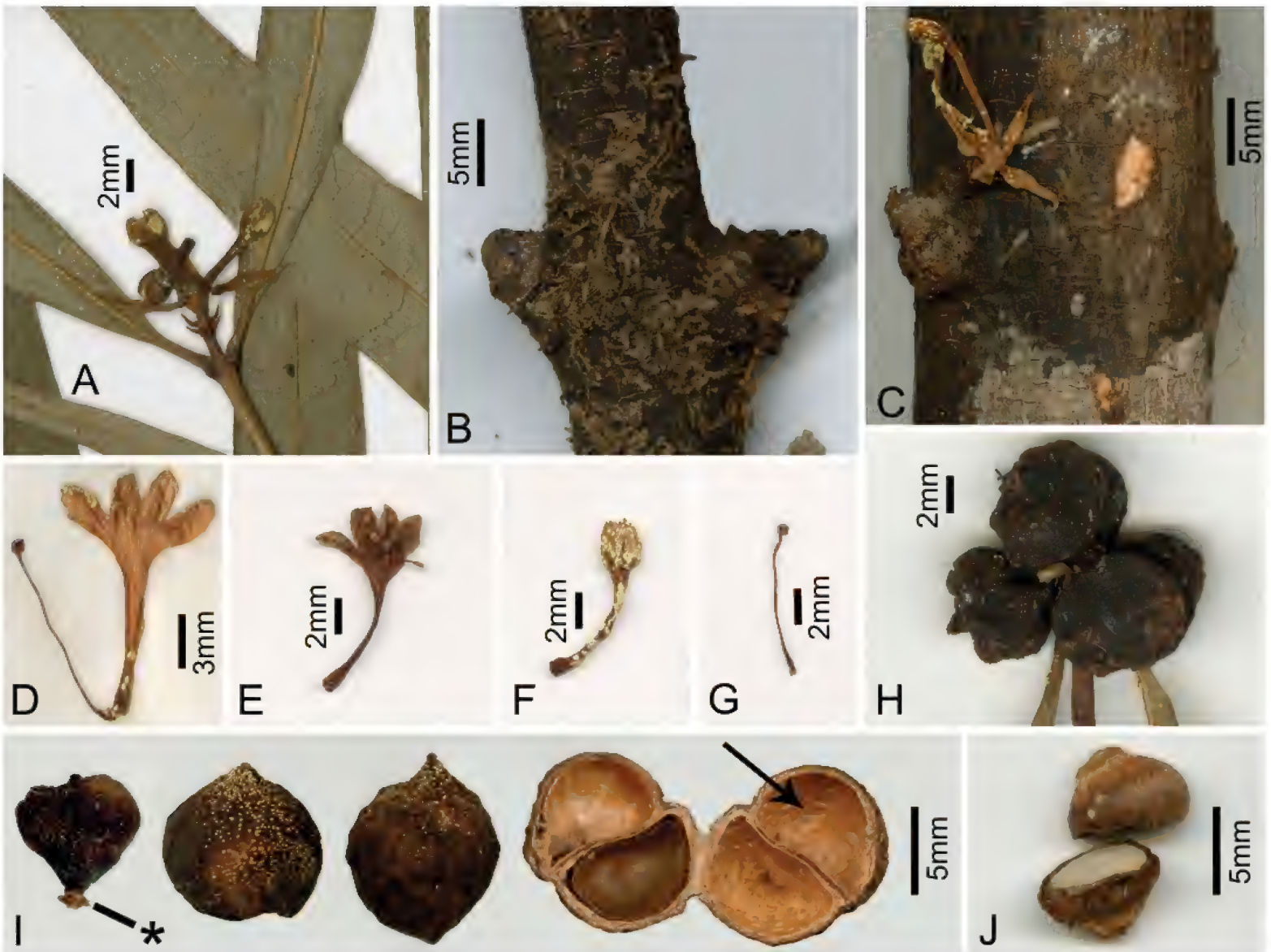

Figure 2. *Phaleria stevensiana* Z. S. Rogers. —A. Flowering branch, showing a terminal inflorescence with flower buds, involucral bracts, bracteoles, and the distinctive leaf venation pattern. —B. Stem node, with the remains of cauliflorous axes ("brachyblasts"). —C. Cauliflorous inflorescence, with one persistent flower bud and four persistent involucral bracts (lower left bract folded back over the central internal axis of the involucre). —D. Flower, dissected. —E. Flower bud, dissected (pistil removed). —F. Flower bud, covered with dense, yellowish blisters that form a "crust" (see discussion). —G. Pistil, removed from dissected flower shown in E. —H. Terminal infructescence of immature fruits. —I. Fruits (from left to right): immature fruit surrounded by remains of persistent hypanthium base (see asterisk); 1-locular, 1-seeded mature fruits (middle two); 2-locular mature fruit in transverse section with both seeds removed. —J. Sectioned seed. All parts photographed from the type collection (*E. Hennipman 5997*). Parts A, B photographed from isotype (A 00460927); part C photographed from isotype (L 0483318); parts D–J photographed from holotype (L 0483317).

in some parts lenticellate. Leaves opposite or rarely subopposite; petiole 3–5 mm, glabrous; leaf blade linear-lanceolate, slightly wider below midpoint, 11.5–17 × 0.7–1.3 cm, with leaf length:width ratio 11–20:1, chartaceous, both surfaces sometimes sparsely to moderately covered with irregular whitish or yellowish blisters on leaf blades and petioles, otherwise glabrous; base attenuate or cuneate; apex tapering very gradually from near midpoint of blade to a blunt or sharp point; midrib slightly adpressed adaxially, abaxially raised and lighter in color than surrounding blade when dry; venation brochidodromous, secondary veins 29 to 35 pairs, sometimes with an additional 1 or less frequently 2 intersecondaries occurring between adjacent secondary pairs, secondaries slightly raised abaxially, veins diverging from midrib at ca. 90° angle before gradually arching to form a vein loop (sinus where secondaries join the vein loop ca. 0.5–1.2 mm from blade margin), first few basalmost veins diverging at more acute angles and running a more strongly arcuate path, fine venation irregularly loosely reticulate and visible on both surfaces; margin entire, slightly undulate and revolute when dry. Inflorescences terminal or cauliflorous, in both cases borne on a short peduncle; peduncle ca. 1.5–1.8 mm, glabrous, basal part of inflorescence axis with 8 scaly bracteoles, those arranged in 4 closely arranged decussate pairs (in one observed terminal inflorescence, see Fig. 2A, a second inflorescence axis ca. 1.6 mm is below the basalmost decussate bract pair); bracteoles 1.4–2.5 × 0.7–1.2 mm, ovate, ± coriaceous, glabrous on both surfaces, apex slightly acuminate or acute; floral fascicles ca. 8-flowered, subtended by 4 involucral bracts; involucral bracts 5.2–7 × 1.4–2.2 mm (sometimes 1 opposing pair slightly narrower), ovate, membranous-chartaceous when dry, both surfaces

glabrous and sometimes sparsely covered with irregular whitish or yellowish blisters, apex acuminate or acute, tip usually slightly rounded. Flowers white, bisexual, subsessile, sparsely to moderately covered with irregular whitish or yellowish blisters when dry, total flower length 1.4–1.5 cm; hypanthium cylindrical, unarticulated, sessile, broader at base and orifice, floral tube 1–1.2 cm, with tube-to-calyx lobe ratio ca. 4.5:1, relatively thin, chartaceous, slightly membranous, glabrous externally and internally, base of tube ca. 0.8 mm wide (ca. 1.2 mm wide rehydrated), orifice of tube ca. 1.5–2 mm wide (ca. 2.2 mm wide rehydrated), tube caducous (ruptured by developing fruit leaving a small amount of the persistent base subtending it); calyx lobes 4, 2.8–3.2 × 2–2.2 mm, broadly ovate, innermost 1 or 2 lobes slightly more narrow, lobes in bud ± ellipsoid, becoming glabrescent on much of both surfaces, with a dense short tomentose pubescence persistent along the margin and on the surfaces of adjacent lobes (especially in places where lobes were adpressed in bud), apex of lobes rounded or rounded-obtuse; orifice scales absent or barely perceptible as darker, sometimes slightly raised or swollen folds, those up to ca. 0.1 mm wide, glabrous, and irregularly located between adjacent filament bases; androecium diplostemonous; stamens 8, glabrous, majority of the filaments in both whorls fused to inner wall of tube, with a short upper portion free and slightly exserted; filaments thin, membranous, narrower approaching anthers; antesepalous filament whorl inserted at orifice, free filament portion ca. 1–1.5 mm; alternisepalous filament whorl inserted ca. 0.2–0.5 mm below orifice, free filament portion ca. 1.3 mm; anthers 0.6–0.8 × 0.4–0.5 mm (rehydrated: ca. 1 × 0.7 mm), oblong, exserted in antesepalous whorl by ca. 1.3 mm and by ca. 0.5 mm in alternisepalous whorl, all anthers dehiscing before flowers open on dried material; subgynoecial disk ca. 0.4–0.5 mm tall, cup-shaped and irregularly divided into 8 to 10 fimbriate segments, disk thin with a membranous-semifleshy texture, glabrous, each segment 0.1–0.3 × 0.1–0.2 mm, rectangular or ovate-oblong, divisions ca. 1/3–1/2 of the total disk height, apical margin truncate or rounded; gynoecium 2-locular, ca. 12.5 mm, glabrous; ovary ca. 1 × 0.5 mm, ovoid and somewhat flattened, glabrous, base ± sessile; style terminal, ca. 10–11 × 0.1 mm, filiform, glabrous; stigma ca. 0.7 × 0.8 mm, subglobose, probably apically slightly depressed or shallowly cleft when fresh, papillate-ciliate (cilia < 0.05 mm), borne at orifice of tube or slightly exserted up to ca. 0.5 mm. Fruits red, drupaceous, 2-seeded (or 1-seeded by abortion), 8.6–11 mm, 2-seeded fruits ca. 11–11.4 mm wide, symmetrical, and ellipsoid-subspheroid or slightly obovoid, 1-seeded fruits ca. 9 mm wide, asymmetrical, ± subspheroid, glabrous, ± shortly attenuate equally at both poles, apical pole sometimes slightly more attenuate, ca. 1–1.5 mm, basal pole ca. 1 mm, base of fruit surrounded by short irregularly torn fragments of floral tube remnants (developing fruit probably ruptures the tube transversely, less likely laterally), persistent tube portion ca. 0.5–0.7 mm (Fig. 2I, see asterisk); pericarp fibrous, relatively thin (ca. 0.2–0.5 mm thick), surface with minute ± uniform punctations, developing yellowish or whitish blisters, those generally more common on the surface of the apical upper half; septum present in 2-seeded fruits, ca. 0.3–0.5 mm wide; endocarp with perforated inner surface and dense, meshlike network of interlaced fibers (Fig. 2I, see arrow), perforations subcircular-asymmetrical, ca. 0.3–0.5(–1) mm diam., more common in basal lower half of fruit. Seeds ca. 8.5 × 7 mm, ca. 5 mm thick, planoconvex (flattened side oriented against sepal wall), outline ± subspheroid, both poles swollen-expanded; seed coat ca. 0.15 mm thick, crustaceous.

Distribution, ecology and phenology. *Phaleria stevensiana* is endemic to Mount Wawonseru, a limestone mountain in South Sulawesi Province, located to the west of Soroako. The mountain has an uneven canopy of primary forest reaching a maximum height of 40–45 m, but a tall, dense canopy only develops over relatively deep soils; rocks with thinner soils only support shrubs (Balgooy & Tantra, 1986). According to the Hennipman label, the new species grows in primary forest between 800 and 1100 m in elevation and was one of the commonest plants at the site. Since it was locally common, it is odd that no other collections have been made, given the relatively high collection density in the vicinity (Cannon et al., 2007), the large amount of limestone in the general area, and the numerous patches of limestone found sporadically along the adjacent Southeast Peninsula (Whitten et al., 2002). According to inventory plot data, no single plant family dominates on Mount Wawonseru, but Lauraceae (six genera) and Annonaceae (two genera) are common; and the site had a total tree density of ca. 715 trees per hectare according to the 1979 survey conducted by Balgooy and Tantra (1986). Whitten et al. (2002) mentioned that both of these families are rare on the ultrabasic soils of the nearby Mount Kondo and pointed out that none of its trees are very common on Mount Wawonseru. About one third of genera co-occur on the two mountains, but in most instances those groups are represented by different species, drawing further attention to the distinctiveness of the two substrate-influenced floras (Balgooy & Tantra, 1986). Some of the largest trees on Mount Wawonseru are species of *Bischofia* Blume, *Eugenia* L., *Podocarpus* L'Hér. ex Pers., and *Vernonia* Schreb., while common lower canopy and understory trees and shrubs

belong to *Polyalthia* Blume and *Antidesma* L. (Whitten et al., 2002). Forest floor plants are sparse and climbers relatively rare, with an undergrowth formed by an assortment of orchids, ferns, native *Piper* L., and species of *Rhynchoglossum* Blume (Balgooy & Tantra, 1986). Mount Wawonseru falls within a perhumid zone (Whitmore, 1984) that receives an average of 2500–3000 mm of rain annually and no less than 100 mm of rainfall in a given month (Whitten et al., 2002).

Phaleria stevensiana was collected in flower and fruit in June.

IUCN Red List category. *Phaleria stevensiana* is known only from the type collected in South Sulawesi Province in 1979. The herbarium label noted that the species was locally common as the "commonest shrub" (Fig. 1). Soroako, also sometimes spelled Sorowako, is mentioned on the label along with a wide-ranging set of latitude and longitude coordinates, but the general locality is in the vicinity of the largest open-pit nickel mine in Indonesia, in operation since 1968 and owned by P. T. Inco, a subsidiary of the massive multinational mining company Vale (Whitten et al., 2002). The company also operates several hydroelectric power stations with dams around Soroako, placing additional stresses on the ecosystems and habitat. Much of the vegetation in the region has been classified as either "open" (completely deforested) or "poor" (heavily degraded, less than 50% forest cover) in GIS analyses (Cannon et al., 2007). A comparison of satellite images of the general region over a two-year period (early 2013 to early 2015) shows that the mine is encroaching westward into suitable forested habitat in conjunction with other detrimental human activities (pers. obs., Google Earth, accessed 30 November 2016). While it is true that international timber exports from the native forests of Southern Sulawesi stopped in 1979, logging continues in all provinces to supply the growing local population, and although the area with its uneven topography and poor water resources is unsuitable for agriculture, it has been and will continue to be used for that purpose (Balgooy & Tantra, 1986). In Sulawesi, humid forest on limestone remains one of the highest conservation priorities (Whitten et al., 2002). Taken together, these activities are clearly harmful to the habitat of the area and are expected to either continue or more likely intensify over time. Given the currently known narrow geographic range (e.g., incalculable extent of occurrence, small area of occupancy), the nearly 40 years since the species was last collected, and the threats to its habitat, *Phaleria stevensiana* is assigned a provisional IUCN (2001) conservation status of Critically Endangered (CR): B1ab(i,ii,iii)+2ab(i,ii,iii).

Etymology. The species is named in honor of Dr. Peter F. Stevens, an exceptional mentor, great scientific mind, long-time collaborator, scholar of Southeast Asian botany, and contributor to a paper on three new Papuasian species of *Phaleria* (Stevens, 1974). In fact, Dr. Stevens's publication remains the largest single paper on new species since the genus was first founded on a single species published by Jack (1822).

Five species previously named after Dr. Stevens are *Rhododendron stevensianum* Sleumer (1973 [Ericaceae]), *Isoetes stevensii* J. R. Croft (1980 [Isoetaceae]), *Trichospermum stevensii* W. N. Takeuchi (1999 [Malvaceae]), *Steganthera stevensii* W. N. Takeuchi (2001 [Monimiaceae]), and *Noronhia stevensiana* Hong-Wa (2016 [Oleaceae]).

Discussion. *Phaleria stevensiana* cannot be placed easily into the existing identification key of Malesian species of Ding Hou (1960), even after taking into account the changes made to the fifth couplet by Stevens (1974) to accommodate his three new species from Papua New Guinea. A new comprehensive key treating all species of the genus throughout their ranges is sorely needed but remains well beyond the scope of the current paper.

Besides the new species, three other *Phaleria* species occur on Sulawesi: *P. capitata*, which is generally found in low, primary and secondary forests (0–800 m in elevation; one collection examined from 1300 m in elevation in Northern Sulawesi); *P. octandra*, which is usually associated with sandy soils in coastal forests at lower (ca. 0–400 m) elevations; and *P. coccinea*, a lowland species once collected on Sulawesi that has more prolific inflorescences made up of longer flowers compared to *P. stevensiana*. About seven scattered populations of *P. capitata* are known on the island, based on a combination of the distribution map provided in Ding Hou (1960) and my own examination of ca. 25 collections of the species, whereas only three Sulawesian populations of *P. octandra* are known, each one based on a single herbarium collection (pers. obs.). *Phaleria capitata* is associated with sand or deep clay and volcanic soils (reported on labels of six of the ca. 25 examined Sulawesian collections), whereas ultramafic (ultrabasic) soil is noted on one of the three known collections of *P. octandra* made from the island. *Phaleria stevensiana* is quite exceptional in that it appears to be restricted to limestone in primary forest at higher elevations (800–1100 m). Limestone is not mentioned on the label of any other Sulawesian *Phaleria* collection, and after broadening my search to include all relevant literature and labels of more than 300 collections, it is obvious that only a few species in the genus are associated with limestone, and even for those taxa, the relationship is an uncommon one—e.g., limestone is

mentioned on labels of two specimens of *Phaleria disperma* (G. Forst.) Baill. (collections from Tonga and Futuna), for two Fijian species vouchered by only one of many collections cited for both species (Smith, 1981), on two unidentified Papua New Guinea specimens, on a single Vanuatu collection, and finally for one of the 10 paratypes of the Papuasian *P. okapensis* P. F. Stevens (Stevens, 1974). Coral was mentioned on the labels of a few of the over 300 examined collections of *Phaleria*. So all of the evidence taken together suggests that *P. stevensiana* is allopatric, separated geographically, ecologically, and also morphologically from the other species.

Phaleria stevensiana is most similar to *P. octandra*. On the basis of vegetative characters alone, *P. stevensiana* can be distinguished from all three contrasted species by its linear-lanceolate leaves (length:width ratios 11–20:1 vs. 2.5–5[–7]:1) with ca. 29 to 35 pairs of secondary veins that diverge from the midrib at ca. 90° angles (vs. 7 to 13 pairs diverging at more acute angles).

Regarding inflorescences and flowers, *Phaleria stevensiana* differs from *P. octandra* by its glabrous involucral bracts (vs. puberulent on both surfaces, denser approaching the apex), shorter filaments and style (vs. both organs longer and more exserted), and shorter, less pubescent calyx lobes. Similarly, the new species can be separated from *P. capitata* by its shorter flowers (ca. 1.4–1.5 vs. 2.5–4.5 cm) and shorter calyx lobes (2.8–3.2 vs. 6–7 mm).

With so few mature fruits of *Phaleria stevensiana* available, it is difficult to comment much about variation and its differences with the other contrasted species. Nevertheless, the fruits of *P. stevensiana* in both of their forms (2-seeded or 1-seeded by abortion, Fig. 2I) do seem to be slightly smaller compared to those of other species. Fruit shape and the degree of attenuation at their poles have been considered important distinguishing characters in the genus (cf. Ding Hou, 1960), but it is important to point out that fruits may change shape during development (e.g., poles tend to shorten or become less attenuated as seeds grow). Moreover, fruits with two seeds will have a different shape compared to 1-seeded fruits, a feature usually obvious even in herbarium material but still overlooked in most of the published taxonomic descriptions and keys. In some cases what have been presented as fruit differences are probably just due to shape and size distortions that arose during the pressing and drying processes, especially in those taxa with more fleshy pericarps.

One interesting fruit feature of *Phaleria stevensiana* is the presence of many perforations on the inner surface of the endocarp that are larger and most common in the basal lower half (Fig. 2I, see arrow). Ding Hou (1960: fig. 3g) and Tawan (2004: fig. 7H) illustrated and described these perforations for *P. capitata* as arising from a meshlike pattern formed by a dense network of interlaced fibers, and went so far as to use these "meshes" as a secondary character to distinguish between a few Malesian species of *Phaleria*. According to Ding Hou (1960), the perforations are always present in *P. capitata*, rarely present in *P. sogerensis* S. Moore in the basal portion of the fruit, and completely absent from the smooth inner surface of the endocarp of *P. octandra*. The perforations in *P. capitata* appear to cover more of the surface of the endocarp compared to what was observed in the few available fruits of *P. stevensiana*. No other accounts of perforations in the family have been found. The character and its taxonomic utility need further study.

Some of the dried material of *Phaleria stevensiana* has a yellowish or whitish "blistering" in varying densities on the surface of several organs—e.g., leaf blades and petioles, involucral bracts (Fig. 2C), flowers (Fig. 2D, 2F), and fruits (Fig. 2I). On most available flower buds, the blistering became so thick it has been described here as a "crust" (Fig. 2F). Perhaps the phenomenon is caused by secretions from the plant, or a byproduct of insect damage, a fungal or bacterial infection, an unidentified environmental factor, or simply tissue degeneration. Whatever the cause of this blistering, it is not isolated to the new species, or the genus *Phaleria*, or to a particular site or region. A similar kind of blister, sometimes also seen adjacent to yellowish flaky residue, has been observed on herbarium material of *P. octandra*, some Filipino collections of *Phaleria*, and in species of a couple of other widespread Indo-Malesian genera (e.g., *Aquilaria beccariana* Tiegh., *A. cumingiana* (Decne.) Ridl., *Gyrinops walla* Gaertn.). Stems of *P. stevensiana* and these other taxa are sometimes lenticellate, but the form of blistering described here has not been seen along branchlets or branches in those cases. The hypothesis that the crust is due to a particular drying or preparation technique seems unlikely, given that this blistering has not been observed at least occasionally in other taxa belonging to this cosmopolitan family of more than 900 species. It is also curious that no other reports of the phenomenon have been published until now. In *P. stevensiana*, the crust on the fruits may be associated with small punctations (pores for gas exchange?) that developed on the pericarp of dried fruits (Fig. 2I); no corresponding source of the punctations was seen on the ovaries inside the flowers of *P. stevensiana*. If the blisters are secretory vessels or represent the actual secretions of the plants themselves, it is reasonable to speculate that even though they may arise from different structures and organs (e.g., lenticels on petioles, stomates on leaves) they may still be chemically similar. There are

conspicuous secretory cavities of mucilaginous cells in the leaves of *Gonystylus* Teijsm. & Binn., subfamily Octolepidoideae, that appear as black punctations in the blade surface, but these are very different from the blisters described here for *Phaleria* and several other Thymelaeoideae.

The habit description on the labels of *Hennipman 5997* is confusing and deserves explanation. First, the collection on the typewritten label is noted as the "[c]ommonest shrub" and then immediately followed by the apparent contradictory description "[t]reelet, ca. 1 m high" (Fig. 1). One explanation could be that the species can be either a shrub or a treelet and that plants with both habits were collected together under the same number. Evidence supporting this possibility is that at least two different plants were gathered and mounted with the same collection number and label at L (sheets L 0483317–L 0483318). Sheet L 0483318 includes a nearly intact mounted single-stemmed treelet, which is fertile, with a terminal inflorescence and single attached immature fruit. The treelet probably had an aboveground height of ca. 65–75 cm (estimate excludes the length of the still-attached roots) that could have been roughly assessed as ca. 1 m tall in the field as reported on the label. So at the least we know that the "treelet" part of the habit description was correct. Besides the treelet mounted on L 0483318, there are also two thicker branches with cauliflorous inflorescences affixed to the same sheet that must have come from one, or possibly two, larger plants. A second possibility for why there are two different habit descriptions is that it was simply due to a mistake made in the field or during label production. Another possibility is that some botanists prefer to describe any shorter woody plant, regardless of whether or not it has a single stem, as a shrub. Of the three Sulawesian species of *Phaleria*, all but two of the ca. 30 combined total examined collections were described as trees, small trees, or treelets; the two exceptions were described as a tall shrub and a 1-m-tall shrublet. Ding Hou (1960) noted that nearly all Malesian species of the genus were either trees or shrubs. Without more information, it seems most likely that the type plant of *P. stevensiana* was a short, thin, single-stemmed treelet, but nevertheless shrub is also included as part of the formal description per Hennipman's label information.

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Diptychandra granadillo, a Notable and Geographically Disjunct New Species of Legume (Leguminosae, Caesalpinioideae) from the Colombian Andes

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Abstract. *Diptychandra granadillo* C. Romero & Arbeláez (Leguminosae, Caesalpinioideae, Caesalpinieae) is described, illustrated, and compared with its most closely related species *D. aurantiaca* Tul. *Diptychandra granadillo* constitutes a new endemic species from the eastern Antioquia Department in the Central Cordillera of Colombia and represents the second species described within the genus *Diptychandra*, which was previously known only from the seasonally dry forests and the Chaco of Bolivia, Brazil, and Paraguay. *Diptychandra granadillo* differs from *D. aurantiaca* by its larger habit, lack of canescent indumentum, larger leaflets, inflorescences in congested conical racemes, longer staminal filaments, and larger fruits and seeds.

Resumen. *Diptychandra granadillo* C. Romero & Arbeláez (Leguminosae, Caesalpinioideae, Caesalpinieae) se describe, ilustra y compara con su especie más cercanamente relacionada *D. aurantiaca* Tul. *Diptychandra granadillo* representa un nuevo endemismo proveniente del oriente del departamento de Antioquia en la Cordillera Central de Colombia y representa la segunda especie descrita dentro del género *Diptychandra* Tul., anteriormente solo conocido de los bosques secos estacionales y del Chaco de Bolivia, Brazil y Paraguay. *Diptychandra granadillo* difiere de *D. aurantiaca* por su hábito arbóreo y masivo, por la ausencia de indumento canescente, por sus folíolos más grandes, la inflorescencia en racimos cónicos congestos, los filamentos estaminales más largos, y por los frutos y semillas mucho más grandes.

Key words: Antioquia, Caesalpinioideae, Cordillera Central, *Diptychandra*, Fabaceae, Flora of Colombia, IUCN Red List, Leguminosae, Neotropical plants.

The Neotropical genus *Diptychandra* Tul. (Leguminosae, Caesalpinioideae, Caesalpinieae) as originally described included one species of small trees and shrubs restricted to central and northeastern Brazil, Paraguay, and Bolivia (Lewis et al., 2005). The only known species of the genus, *D. aurantiaca* Tul., comprises two morphologically distinct allopatric groups that are currently treated as subspecies: *D. aurantiaca* subsp. *aurantiaca*, from central Brazil and adjacent areas, and *D. aurantiaca* subsp. *epunctata* (Tul.) H. C. Lima, A. M. Carvalho & C. G. Costa, from northeastern Brazil, Bolivia, and Paraguay (Lima et al., 1990; Neill et al., 2014). Members of *Diptychandra* grow at low elevations in seasonally dry forests but can also be found in Chaco vegetation, gallery forests, rocky grasslands, thorn scrub or woodland (caatinga), and wooded grasslands (savanna, cerrado) (Lewis et al., 2005).

Within the subfamily Caesalpinioideae, *Diptychandra* belongs to the tribe Caesalpinieae, which was divided by Polhill and Vidal (1981) and Polhill (1994) into eight informal groups based solely on morphological characters. The Neotropical genera *Sclerolobium* Vogel, *Tachigali* Aubl., and *Diptychandra* were placed in the *Sclerolobium* group, characterized by having regular to zygomorphic flowers, small isomorphic petals, a cupular hypanthium, anthers with lateral dehiscence, and a small stigma. Molecular phylogenetic studies analyzing a wide sampling of members of Caesalpinieae and allies raise questions about the monophyly of the *Sclerolobium* group of Polhill and Vidal (1981), since *Tachigali* and *Sclerolobium* are closely related to *Arapatiella* Rizzini & A. Mattos and *Jacqueshuberia* Ducke of the *Tachigali* group of Lewis et al. (2005), while the placement of *Diptychandra* within the Leguminosae remained uncertain (Lewis et al., 2005; Maia, 2008). Recent phylogenetic hypotheses based on molecular sequence data (Haston et al., 2003; Maia, 2008) found *Diptychandra* together with other genera of Caesalpinieae within a polytomy; and thus, the informal *Sclerolobium* group of Polhill and Vidal (1981), with *Sclerolobium*, *Tachigali*, and *Diptychandra* as closely related taxa, has been definitively rejected.

In *Diptychandra* the pollen is presented in tetrads, an unusual feature in Caesalpinioideae (Cowan, 1981;

Graham & Barker, 1981). Although Goldblatt's (1981) review of the distribution of chromosome numbers in Leguminosae remains the most comprehensive treatment of chromosomal variation in the family, the basic chromosome number of *Diptychandra* has not been reported to date. Only around 54% of legume genera have chromosome counts reported, and the percentage is far lower for tropical woody groups (Doyle, 2012). However, Polhill and Vidal (1981) reported that the tribes Caesalpinieae and Cassieae are both diploid based on $x = 14$, and Goldblatt (1981) stated that although polyploidy has been reported only in few genera of Caesalpinioideae, the subfamily as a whole is considered to be polyploid, with a prevalence of tetraploids with the basic number $x = 7$ (Bandel, 1974; Goldblatt, 1981; Souza & Benko-Iseppon, 2004). These findings may suggest that the genus *Diptychandra* could possibly be polyploid, but detailed cytological studies are needed to confirm this.

Antioquia is one of the 32 political departments of Colombia and is located in the northwest of the country where it covers an area of 63,612 km^2 (24,427 sq. mi.), almost 6% of the continental area of Colombia (IGAC, 1996). Its flora represents almost 34% of the vascular plants of Colombia (Idárraga-Piedrahita & Callejas-Posada, 2011). Due to its mountainous topography and habitat heterogeneity, Antioquia is considered one of the most diverse areas in all the Neotropics for vascular plants, encompassing nearly 6% of the endemic plants expected to be found in Colombia (Idárraga-Piedrahita & Callejas-Posada, 2011).

Study of the Leguminosae collections at the Missouri Botanical Garden Herbarium (MO) showed that specimens of *Diptychandra* collected from Antioquia differ from the only known species, *D. aurantiaca*. These populations are described here as the second species of this genus.

Taxonomy

Diptychandra granadillo C. Romero & Arbeláez, sp. nov. TYPE: Colombia. Antioquia: Mpio. de San Carlos, Km 5.6 of rd. Juanes–Corregimiento Alto Samaná, 1.6 km past rd. to top of Punchiná dam, 06°10′N, 74°52′W, 800 m, 20 May 1988 (fl.), *J. L. Zarucchi, P. Velásquez & O. Escobar 6759* (holotype, HUA!; isotypes, COL!, K!, MO!, NY!). Figures 1, 2.

Diagnosis. *Diptychandra granadillo* C. Romero & Arbeláez is similar to *D. aurantiaca* Tul. but differs in its tree habit up to 40 m in height (vs. up to 10 m) with its trunk weakly buttressed at the base (vs. not buttressed); vegetative parts glabrous to subglabrous (vs. canescent); larger leaflets, 3–10.3 × 2–4.9 cm (vs. 0.65–7.5 × 0.4–4.1 cm); inflorescences always solitary (vs. 1 to 3 peduncles per axil), congested conical racemes (vs. lax cylindrical racemes); reproductive parts densely crisped-puberulous to tomentulose (vs. densely canescent); longer staminal filaments, 1.1–1.7 cm (vs. 0.5–0.7 cm); and larger fruits and seeds, the legume 16.5–28 × 3–4 cm (vs. 4.1–16 × 1.5–3.4 cm) and the seeds including wings ca. 9 × 4 cm (vs. 4.1–6.4 × 2–2.75 cm).

Trees, up to 40 m tall. Trunk weakly buttressed at the base. Bark externally very hard, corky, scaly and fissured, internally white or cream. Young shoots terete, glabrous, or subglabrous to glabrescent, profusely lenticellate, lenticels the same color as young shoots. Stipules 0.1–4 mm, ovate-lanceolate, crisped-puberulous, caducous. Leaves alternate, compound, paripinnate; pulvinulus present and thickened. Petiole 2.4–3 cm, canaliculate, glabrous. Foliar rachis 8–15 cm, canaliculate. Petiolules thickened, 2.5–4 mm. Leaflets 4 or 5 pairs (8 to 10 leaflets total), coriaceous or chartaceous, opposite on the rachis; basal leaflets 3–6.4 × 2–3.5 cm, ovate, at apex acuminate to cuspidate, at base obtuse to rounded; terminal leaflets 5–10.3 × 3–4.9 cm, ovate-elliptic, at apex cuspidate, at base cuneate; leaflet lamina glabrous adaxially, glabrous to profusely glandular-punctate abaxially; leaflet venation pinnate-reticulate, brochidodromous, with secondary veins 9 to 12 pairs, parallel and weakly arcuate toward the margins, secondary venation slightly prominent on both surfaces. Inflorescences axillary and opposite the leaves, always solitary (1 peduncle per axil), congested conical racemes; peduncle 2.5–3.5 cm, densely crisped-puberulous; floral rachis up to 8.5 cm, densely crisped-puberulous; floral bracts absent; floral pedicel 5–10 mm, longer in basal flowers than apical ones, profusely and densely crisped-puberulous and yellow-ochre in color. Flowers hermaphrodite, actinomorphic; hypanthium 3–5 mm, infundibuliform, smooth to weakly longitudinally striated, externally densely crisped-puberulous, internally glabrous; sepals 5, free, 4–5 mm, imbricate in bud, densely crisped-puberulous to tomentulose, pale yellow-ochre; petals 5, free, 1–5 mm, sparsely crisped-puberulous externally and internally, weakly venulose, yellow. Stamens 10, free, exserted; filaments 1.1–1.7 cm, crisped-puberulous toward the base and glabrous above; anthers dorsifixed near base, extrorse, open by lateral slits. Ovary of 1 carpel, superior, densely crisped-puberulous and glabrous toward the base and glabrous above, 1–9 mm; style and stigma 4–6.1 mm, crisped-puberulous toward the base, apex subglabrous; stigma simple, head not expanded. Legume dehiscent along both margins, 16.5–28 × 3–4 cm, flat, linear-oblong, straight, at apex rounded to acute or short-apiculate, at base acute to cuneate, externally smooth and shiny with faint venation and scattered lenticels, glabrous, dark brown, internally ochre-yellow and smooth. Seeds winged, transversely oblong, ca. 9 × 4 cm overall (seed portion ca. 3.8 × 1.6 cm; wings projecting from the border of the seed 2.5–3.2 cm).

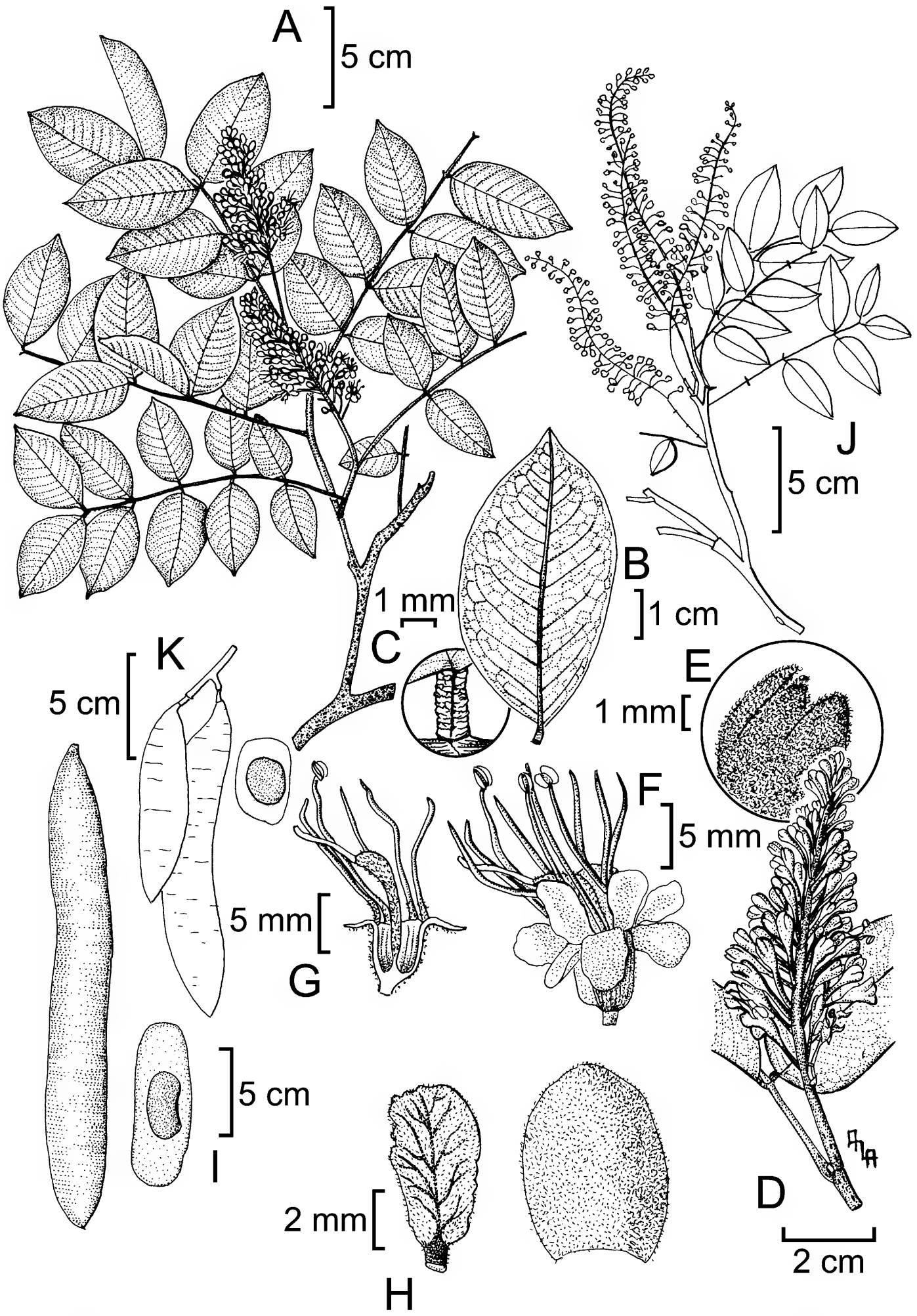

Figure 1. A–I. *Diptychandra granadillo* C. Romero & Arbeláez. —A. Flowering branch. —B. Leaflet abaxial side. —C. Leaflet pulvinule. —D. Inflorescence. —E. Detail of the calyx lobes in flower bud. —F. Flower at anthesis. —G. Longitudinal section of the flower showing hypanthium and ovary. —H. Detail of the perianth: left, petal; right, sepal. —I. Legume and winged seed. J, K. *Diptychandra aurantiaca* Tul. —J. Flowering branch. —K. Legume and winged seed. A–H, drawn from the isotype (MO); I, drawn from *D. D. Soejarto et al. 3920* (MO); J, drawn from *E. Hassler 10678* (MO); K, legume drawn from *R. Quevedo et al. 2552* (MO), seed from *R. Quevedo & T. Centurión 497* (MO). Illustration prepared by Alba L. Arbeláez.

Figure 2. Distribution of *Diptychandra aurantiaca* Tul. (♦) and *D. granadillo* C. Romero & Arbeláez (●).

Etymology. The specific epithet refers to the local common name for these trees, "granadillo." *Platymiscium* Vogel (Leguminosae, Papilionoideae), which is also called "granadillo," has similar hard wood and general appearance.

Distribution and habitat. *Diptychandra granadillo* is known only from Antioquia Department in northwestern Colombia, where it grows in areas of tropical wet and tropical submontane forests (IGAC, 2002) at elevations between 350 and 900 m. This new species is found in

the physiographic zones of the western slopes of the Cordillera Central (municipality of San Carlos; see the type specimen) and in the canyon and valley of the lower Cauca River (municipality of Anorí; see paratypes) (Fig. 2).

Phenology. Flowering has been reported in May, August, and September. Fruiting has been reported in May and September.

Common names and uses. *Diptychandra granadillo* has been called "granadillo" and "costillo" (Antioquia Department, Colombia). In Antioquia, the wood of *D. granadillo* is used for its hardness and durability and is said to last for years even when used as a post in wet ground (*Shepherd 530*, in sched., MO). The wood has been reported to be very hard and difficult to saw and is even said to break an ax (*Soejarto et al. 3920*, in sched., HUA, MO; *Zarucchi 3323*, in sched., MO).

IUCN Red List category. *Diptychandra granadillo* is known from few collections, corresponding to two different areas in northwest Colombia located in the municipalities of San Carlos and Anorí (Antioquia Department). Although both areas have been well documented in terms of botanical collections (Idárraga-Piedrahita & Callejas-Posada, 2011), they are not protected within the National Natural Parks system or the National System of Protected Areas of Colombia (Latorre-Parra et al., 2014), and therefore the habitats of the current populations of *D. granadillo* are subject to ongoing decline in quality or extent. The species is therefore here assessed following the IUCN (2012) guidelines as Endangered, EN B2ab(iii).

Discussion. *Diptychandra granadillo* is a large tree, with individuals up to 40 m in height and 1.3 m DBH, with weak buttresses at the base, abundant yellow flowers, and dark brown fruits. The genus *Diptychandra* is characterized by having regular flowers with uniform stamens, dehiscent fruits, winged seeds, and petioles not winged; the other known species in the genus, *D. aurantiaca*, is a shrub or small tree. *Diptychandra granadillo* lacks the canescent indumentum of *D. aurantiaca* and has in general longer leaflets and more robust inflorescences, with dense conical racemes

Table 1. Morphological differences between *Diptychandra aurantiaca* Tul. and *D. granadillo* C. Romero & Arbeláez.

	D. aurantiaca	*D. granadillo*
Distribution	Bolivia, Brazil, and Paraguay	Colombia (Antioquia)
Habit	shrubs or small trees (up to 10 m tall)	large trees up to 40 m tall
Trunk	not buttressed	weakly buttressed at the base
Indument of vegetative parts	canescent	glabrous to subglabrous
Lenticels	lighter than the color of young shoots	same color as young shoots
Petiole length	0.9–3.5 cm	2.4–3 cm
Petiolule length	2–2.5 mm	2.5–4 mm
Number of leaflet pairs	(2 to)4 or 5(or 6)	4 or 5
Size of basal pair of leaflets	0.65–5 × 0.4–4.1 cm	3–6.4 × 2–3.5 cm
Size of terminal pair of leaflets	2.6–7.5 × 1–3.7 cm	5–10.3 × 3–4.9 cm
Number of inflorescences/axil	1 to 3	1
Inflorescence form	lax, cylindrical raceme	congested, conical raceme
Peduncle length	1.5–4.5 cm	2.5–3.5 cm
Indument of reproductive parts	densely canescent	densely crisped-puberulous to tomentulose
Rachis length	4.3–10 cm	up to 8.5 cm
Hypanthium length	1–2 mm	3–5 mm
Hypanthium shape	cupuliform-infundibuliform	narrowly infundibuliform
Filament length	0.5–0.7 cm	1.1–1.7 cm
Ovary indument	densely minutely villous	densely crisped-puberulous
Ovary length	up to 3 mm	up to 9 mm
Style and stigma indument	glabrous	crisped-puberulous toward the base
Legume size	4.1–16 × 1.5–3.4 cm	16.5–28 × 3–4 cm
Legume shape	oblong to elliptic	linear-oblong
Legume external color	yellowish green to light brown	dark brown
Seed size (including wings)	4.1–6.4 × 2–2.75 cm	ca. 9 × 4 cm

whose crisped-puberulous to tomentulose flowers (vs. densely canescent in *D. aurantiaca*) have longer staminal filaments. The dimensions of the legume and seed are also quite distinct in both species, with those of *D. granadillo* larger and more massive than the ones of *D. aurantiaca*. The geographical distribution also separates them: *D. aurantiaca* has been reported in Bolivia, Brazil, and Paraguay, while *D. granadillo* is an endemic species found only in the Antioquia Department (Colombia). The characters that distinguish both taxa are listed in detail in Table 1.

There are also marked geographical and environmental differences between these two species of *Diptychandra*. While *D. aurantiaca* grows on the lowlands of Bolivia, Brazil, and Paraguay between 100 and 900 m.s.m. in areas of seasonally dry forests, *D. granadillo* grows on the western slopes of the Cordillera Central in the Colombian Andes at elevations between 350 and 900 m in areas occupied by wet and tropical submontane forests (see Fig. 2). The species are separated by more than 3000 km, which represents a large geographic disjunction between them. The origin, diversification, and consequent morphological disparity of *D. granadillo* could be explained by the long geographical isolation experienced by these populations due to the geological origin and evolution of the eastern, central, and western Cordilleras in Colombia (Gregory-Wodzicki, 2000). Population genetics studies as well as phylogenetic systematics coupled with morphological analyses could give us a better understanding of the evolutionary relationships and diversification within *Diptychandra*.

Paratypes. COLOMBIA. **Antioquia:** Río Anorí valley, near Planta Providencia, 350–600 m, 10 Aug. 1976 (fl.), *J. D. Shepherd 530* (MO); mpio. de Anorí, corregimiento de Providencia, Valle del río Anorí, entre Dos Bocas y Anorí, Buenos Aires, 400–700 m, 26 Apr.–3 May 1973 (fr.), *D. D. Soejarto, J. Zarucchi, E. Rentería & R. Warner 3920* (HUA, MO); mpio. de Anorí, corregimiento de Providencia, Valle del río Anorí, entre Dos Bocas y Anorí, 400–900 m, 6–12 Sep. 1973 (fl.), *D. D. Soejarto, R. Fonnegra, P. Havens & J. White 4340* (MO); Valley of río Anorí, betw. Dos Bocas & Anorí, Planta Providencia and vic., 07°21′N, 75°03′W, 450–550 m, 30 Sep. 1984 (fr.), *J. L. Zarucchi 3323* (MO).

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A Necessary Combination in *Downingia* (Campanulaceae) for the North American Flora

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Abstract. The following new combination in Campanulaceae is proposed: *Downingia ornatissima* Greene var. *mirabilis* (J. T. Howell) Schultheis & Zarucchi.

Key words: Campanulaceae, *Downingia*, North America.

During the course of reviewing treatments of various genera for the *Flora of North America North of Mexico*, the second author encountered a situation where a new varietal combination needed to be made in *Downingia ornatissima* Greene as required by the International Code of Nomenclature (ICN) (McNeill et al., 2012). The varietal combination often used for this plant, *D. ornatissima* var. *eximia* (Hoover) McVaugh, is not correct because of Art. 11.6 of the ICN: "An autonym is treated as having priority over the name or names of the same date and rank that established it." The publication of *D. mirabilis* J. T. Howell var. *eximia* Hoover established the corresponding autonym *D. mirabilis* var. *mirabilis*, and the two are now treated as taxonomic synonyms.

Downingia ornatissima Greene var. **mirabilis** (J. T. Howell) Schultheis & Zarucchi, comb. nov. Basionym: *Downingia mirabilis* J. T. Howell, Leafl. W. Bot. 1: 221. 1936. TYPE: U.S.A. California: Merced Co., 5 mi. N of Merced, 25 Apr. 1929, *J. T. Howell 4200* (holotype, CAS-232457!).

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Two New Species of *Viburnum* (Viburnaceae) from the Tropical Andes

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ABSTRACT. *Viburnum obtectum* H. Vargas and *V. stipitatum* H. Vargas are described as new species. They differ from all other Ecuadorian species of *Viburnum* L. by having marginal teeth along the whole margin of the leaves, while such teeth in other species are restricted to either the basal or apical half of the leaf. Differences between the two new species are expressed particularly on the abaxial leaf surface. *Viburnum obtectum* is extremely densely pubescent; the indument completely obscures the abaxial leaf surface, and the stellate trichomes are almost always sessile. *Viburnum stipitatum* has a visible abaxial leaf surface, with long-stalked stellate trichomes having a forest-like appearance. A key to the *Viburnum* species in Ecuador is provided, as well as illustrations of the new proposed species.

Key words: Andes, Ecuador, Viburnaceae, *Viburnum*.

Viburnum L. (Viburnaceae) is a widespread genus that consists of about 175 species (Stevens, 2002), which are native to north temperate regions and to mountainous areas in the tropics. The genus is rare in the Antilles and absent from New Zealand and Australia (D'Arcy, 1973). *Viburnum* in America is located in the east of North America, the mountainous regions of Mexico, and Central America (Donoghue, 1983). In South America, with the exception of *V. roraimense* Killip & A. C. Sm. from Mount Roraima, Guyana, the genus is confined to the Andes from Venezuela to Argentina (Killip & Smith, 1931). In Ecuador, it is principally found in montane cloud forest at elevations of 750–3800 m.

Viburnum species are trees or shrubs with simple, decussate or whorled, petiolate, chartaceous or coriaceous leaves and umbel-like inflorescences. The flowers are small, actinomorphic, 5-merous, and fragrant; the corolla is white to light cream, rotate or tubular, with stamens adnate to the base of the corolla tube; the oblong anthers are exserted, dorsifixed, and versatile; and the stigmas are 3-lobed. Fruits are drupaceous and 1-seeded with persistent sepals; seeds are longitudinally grooved with fleshy endosperm and minute embryos.

While revising the genus in Ecuador, we had an opportunity to examine about 1800 specimens representing all taxa from this country (Vargas, 2002). We also examined material from Colombia and Peru and updated determinations based on the examination of the type collections of almost all South American species. During this revision two new species were detected. They are described below, and their distinguishing characters are discussed.

1. Viburnum obtectum H. Vargas, sp. nov. TYPE: Ecuador. Loja: Yangana, rd. Yangana–Valladolid, Km. 12.1, 2240 m, 1 June 2001, *H. Vargas 4109* (holotype, QCNE!; isotype, MO!). Figures 1, 2A.

Diagnosis. *Viburnum obtectum* H. Vargas is distinguished from all previously described Ecuadorian species of *Viburnum* L. by having glandular teeth irregularly distributed along the whole margin of the leaf (vs. only along the apical half of the leaf margin [in *V. pichinchense* Benth., *V. jamesonii* (Oerst.) Killip & A. C. Sm., *V. divaricatum* Benth., and *V. hallii* (Oerst.) Killip & A. C. Sm.] or along the basal half of the leaf margin [in *V. toronis* Killip & A. C. Sm. and *V. triphyllum* Benth.]); it differs from *V. stipitatum* H. Vargas, described below, in having an extremely densely pubescent abaxial leaf surface entirely obscured by trichomes, stellate trichomes sessile or occasionally shortly stalked to 0.1 mm (vs. longer-stalked, 0.2 mm), with branches 0.2–0.4(–0.5) mm (vs. 0.3–0.6[–0.7] mm); medial abaxial cuticular surface of leaf lamina with undulate anticlinal waxed walls (vs. striate periclinal walls without waxes); longer floral bracts, 2–3.5(–4.2) mm (vs. 1.2–2.5 mm); and fruit ellipsoid to spheroid (vs. ovoid to broadly ellipsoid).

Trees or shrubs 1.5–10 m tall, DBH 1.3–12.7 cm; twigs 3–5 mm diam., indument white-cream to golden, pubescent to densely pubescent when young; internodes 1.6–5(–8) cm; vegetative bud scales 2 pairs, outer scales glabrous to pubescent, inner scales pubescent. Leaves decussate, rarely whorled; petiole 0.7–2.5 cm, sparsely to densely pubescent, with a pair of glands at the apex of the petiole; lamina (4.2–)5.5–13(–19.2) × 3–7(–9.4) cm, elliptic, broadly elliptic, ovate, or broadly ovate, coriaceous; base cuneate to rounded; apex retuse or acute to acuminate; margin serrate with 4 to 16(to 25) irregularly distributed teeth, glabrous to ciliate; adaxial surface sparsely pubescent, medial cuticular surface

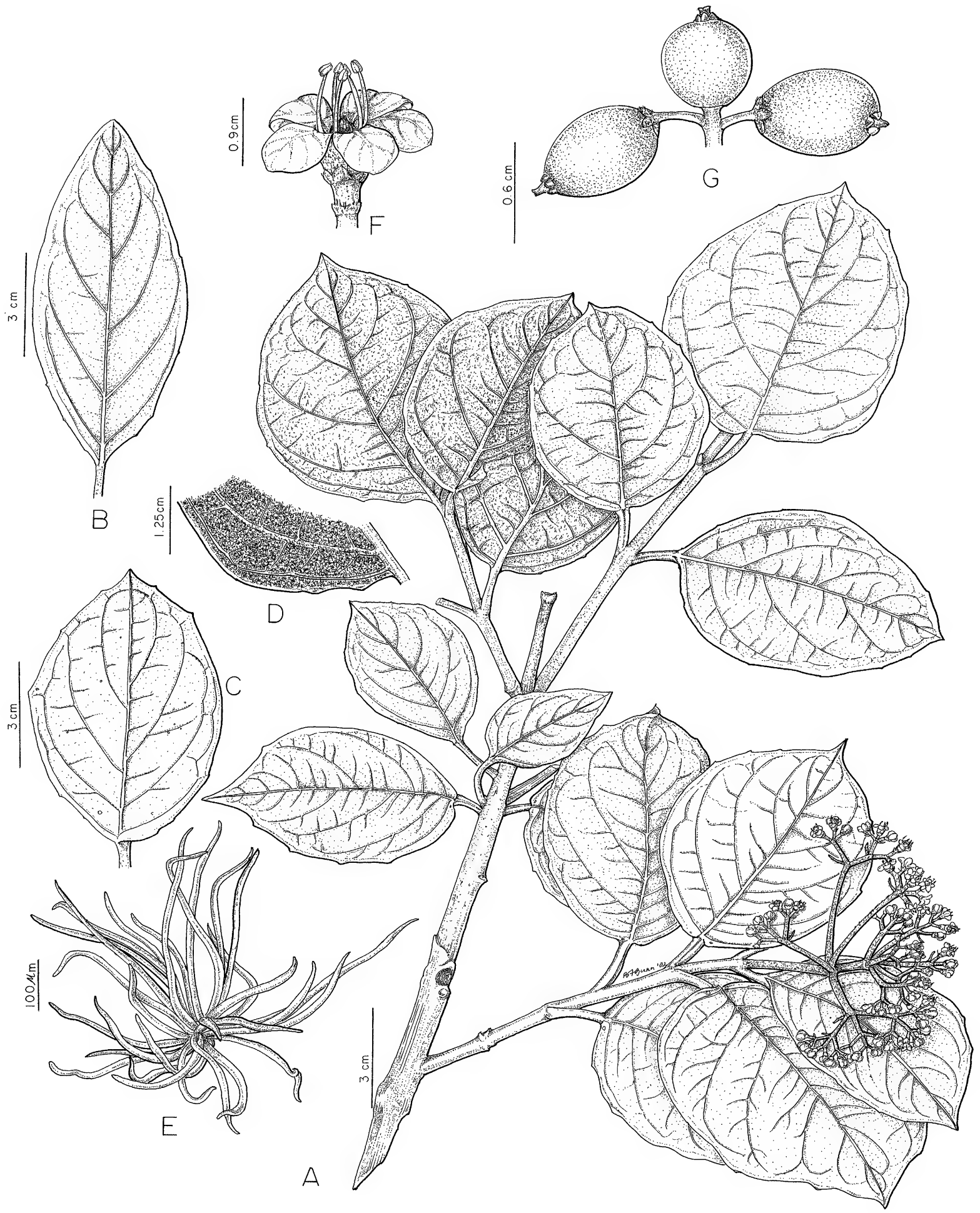

Figure 1. *Viburnum obtectum* H. Vargas. —A. Flowering branch. —B. Elliptic leaf. —C. Broadly elliptic leaf. —D. Densely pubescent abaxial leaf surface. —E. Sessile stellate trichome. —F. Flower. —G. Fruits. A, D drawn from *Harling & Andersson 21995* (GB); B, F, G drawn from the isotype, *Vargas 4109* (MO); C drawn from *Madsen 85821* (QCA); E drawn from *Vargas 4108* (MO).

with undulate anticlinal waxed walls; abaxial surface densely pubescent, trichomes always stellate, sessile or occasionally some shortly stalked with stalk to 0.1 mm, trichome branches 0.2–0.4(–0.5) mm; midrib pubescent, immersed above, prominent below; secondary veins semicraspedodromous, 4 or 5(to 7) pairs. Inflorescences terminal, umbellate (subumbellate), (2.4–)4–7.5 × (4.9–)6–10.8(–14) cm, pubescent to densely pubescent; peduncle (1.8–)3.8–6.8(–10) cm; primary rays 6 or 7(to 9), 1.1–4.4(–5.2) cm, 1–2 (–2.5) mm diam., primary bracts 3–19 mm; secondary rays 0.4–2(–2.6) cm; secondary bracts 2.3–5 mm;

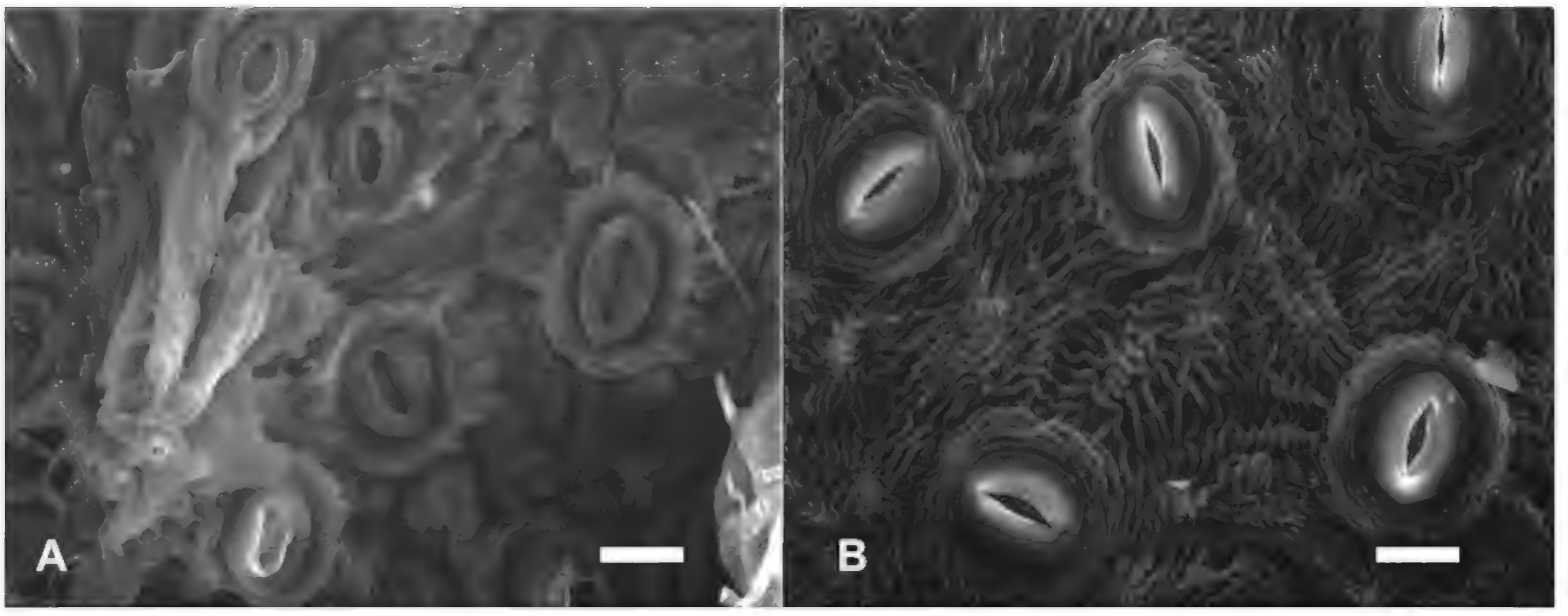

Figure 2. SEM micrographs of abaxial cuticular surface. —A. *Viburnum obtectum* H. Vargas, showing undulate anticlinal walls (*Vargas 4108*, MO). —B. *Viburnum stipitatum* H. Vargas, showing striate periclinal walls without waxes (*Øllgaard et al. 74776*, AAU). Scale bars = 10 μm.

tertiary rays 0.2–0.9 cm; tertiary bracts 2.3–4.5 mm; flowers 1 to 3(or 4) per tertiary ray, with trichomes simple, furcate, or sessile stellate, pedicel up to 3(–4) mm; floral bracts 2–3.5(–4.2) mm; bracteoles 1–2 mm. Sepals 0.8–1.5 mm, triangular, erect, abaxially sparsely pubescent, adaxially glabrous, margin crenate, ciliate; receptacle 1–1.5 mm, sparsely pubescent to pubescent; petals white, 2.5–3.5(–4) mm, glabrous to sparsely pubescent; filaments 3–4(–5.3) mm, anthers 1–1.5 mm; style glabrous (rarely sparsely pubescent), stigma glabrous, maroon, 3-lobed. Fruits black, glabrous to sparsely pubescent, ellipsoid to spheroid, 6–10 × 4–8 mm; endocarp 5.5–9.5 × 5–8 mm, groove undivided or Y-shaped, 0.6–1.5 mm wide, 0.6–1.5 mm deep; seed 5–7.4 × 3.6–6.2 mm.

Distribution. *Viburnum obtectum* is found in the tropical Andes: in Colombia, in the central and northwestern part in the departments of Antioquia, Quindio, and Valle del Cauca; in Ecuador, in the southern part of the eastern cordillera, in the provinces of Loja and Zamora-Chinchipe; and in Peru, in the northern part in the department of Amazonas (Fig. 4). Individuals have been collected from wet montane forest and montane tropical forest at elevations of 2000–3050 m.

Etymology. The specific epithet refers to the dense pubescence on the abaxial surface of the leaf.

Discussion. *Viburnum obtectum* resembles *V. stipitatum*, described below, in many features and shares the character of glandular teeth irregularly distributed along the whole margin, which is otherwise unknown in Ecuadorian species. It differs from *V. stipitatum* by having the abaxial leaf surface extremely densely pubescent and entirely obscured by trichomes; the stellate trichomes are sessile or rarely shortly stalked, with the stalk, when present, only 0.1 mm long. In *V. stipitatum*, the abaxial surface is pubescent but the surface is visible; the stellate trichomes are stalked, with the stalk 0.2 mm long. Furthermore, the floral bracts in *V. obtectum* are longer, 2–3.5(–4.2) mm long (vs. 1.2–2.5 mm long in *V. stipitatum*).

By contrast, all other Ecuadorian species of *Viburnum* differ from *V. obtectum* in several features. Thus, *V. toronis* can be recognized by its larger decussate leaves; its abaxial leaf surfaces are mostly glabrous but densely pubescent in the vein axils. *Viburnum triphyllum* is readily distinguished by its small, narrowly elliptic or elliptic to ovate leaves and small, compact inflorescences. *Viburnum divaricatum* is characterized by its lax, wide-spreading inflorescences and leaves with the secondary veins craspedodromous in the apical part and the abaxial surface sparsely pubescent with simple, furcate, sessile trichomes and shortly stalked stellate trichomes. *Viburnum hallii* is notable for its indument on the abaxial leaf surface, which is sparsely pubescent or densely pubescent in the axils: the trichomes are simple, furcate, and sessile stellate. *Viburnum pichinchense* can be recognized by the rufous-pubescent abaxial surface of its leaves; the trichomes are sessile or stalked stellate. *Viburnum jamesonii* is distinguished by its yellow to brown indumentum on the abaxial surface of the leaves, which is particularly dense on each side of the veins.

Paratypes. COLOMBIA. **Antioquia:** Jardín, rd. Jardín–Riosucio, 13 km from Jardín, Ventanas, 05°35′N, 75°52′W, 2100–2400 m, 8 June 1987, *R. Callejas 3848* (MO); Guarne, Parque Ecológico Piedras Blancas, 06°18′N, 75°29′W, 2300–2400 m, 21 Oct. 1995, *R. Fonnegra et al. 5653* (MO); La Unión, La Pasiva, Km. 4, 05°56′N, 75°20′W, 2000–2300 m, 22 June 1992, *A. Gómez 628* (MO); Entrerríos, rd. betw. Entrerríos & San Pedro, 12 km from Entrerríos, 10.9 km from San Pedro, 06°30′N, 75°32′W, 2350–2385 m,

5 Feb. 1989, *J. M. MacDougal & F. J. Roldán 3670* (MO); Piedras Blancas, Represa Piedras Blancas, 06°15′N, 75°30′W, 2290 m, 11 Feb. 1984, *F. J. Roldán 85* (MO); Santa Rosa, El Guásimo, 06°35′N, 75°25′W, 2300 m, 6 Sep. 1990, *D. Sánchez 1275* (MO); Sonsón, rd. Sonsón–Nariño, Km. 12, 05°42′N, 75°15′W, 2630 m, 6 Dec. 1986, *J. L. Zarucchi & N. Bedoya 4424* (MO); Medellín, rd. Medellín–Santa Fé de Antioquia, Cerro del Padre Amaya, 06°18′N, 75°41′W, 2640 m, 10 Mar. 1987, *J. L. Zarucchi & B. E. Echeverry 4599* (MO); Sonsón, Km. 11 of rd. Sonsón–Nariño (25 km from Nariño) near Km. post 151 marking distance from Bogotá, 05°42′N, 75°15′W, 2780 m, 1 Apr. 1987, *J. L. Zarucchi et al. 5213* (MO); Salgar, rd. Salgar–El Dauro, Km. 15, 05°59′N, 76°07′W, 2280 m, 29 Sep. 1987, *J. L. Zarucchi et al. 5997* (MO), 2320 m, 30 Sep. 1987, *J. L. Zarucchi et al. 6049* (MO); La Ceja, rd. La Ceja–La Unión, 06°00′N, 75°24′W, 2320 m, 2 Oct. 1987, *J. L. Zarucchi et al. 6117* (MO); rd. La Unión–Sonsón, Km. 14, 05°55′N, 75°20′W, 2420 m, 2 Oct. 1987, *J. L. Zarucchi et al. 6139* (MO); San Pedro, rd. San Pedro–Entrerríos, Km. 5, 06°29′N, 75°33′W, 2340 m, 7 May 1988, *J. L. Zarucchi & D. L. Echeverri 6312* (MO); San José de la Montaña, rd. Toledo–San José de la Montaña, Km. 21, 06°52′N, 75°42′W, 2480 m, 13 May 1988, *J. L. Zarucchi & J. C. Betancur 6525* (MO); Km. 16 of rd. La Unión–Sonsón (40 km before Sonsón), 05°54′N, 75°20′W, 2360 m, 15 May 1988, *J. L. Zarucchi et al. 6617* (MO). **Quindio:** rd. from Pijao to Páramo de Chilí, 04°17′N, 75°40′W, 2700–2800 m, 30 Jan. 1989, *A. H. Gentry & M. C. Vélez 65339* (MO). **Valle del Cauca:** Santa Lucía, finca Las Nieves, páramo Las Hermosas, 3200 m, 24 Sep. 1987, *W. Devia & F. Prado 1951* (MO). ECUADOR. **Loja:** Parque Nacional Podocarpus, Yangana, Km. 16 from Yangana–Zumba, 04°27′S, 79°11′W, 2500 m, 8 Sep. 1997, *C. E. Cerón & L. E. Ocampo 34987* (LOJA); rd. Loja–Zamora, Cerro Numa, 03°59′S, 79°09′W, 2700 m, 28 Sep. 1995, *A. Garmendia & G. Paredes 333* (MA); Yangana–Nudo de Sabanilla, 2200–2400 m, 13 Feb. 1993, *G. Harling & B. Ståhl 26348* (S); 14 km E of Loja, 04°00′S, 79°02′W, 2850 m, 15 May 1965, *D. H. Knight 853* (US); rd. Loja–Zamora, Km. 9, 03°58′S, 79°10′W, 2600 m, 2 May 1997, *G. P. Lewis 3223* (LOJA, MO, QCNE); Parque Nacional Podocarpus, Cajanuma, trail to El Mirador, 04°06′S, 79°10′W, 2900 m, 26 July 1997, *G. P. Lewis & P. Lozano 3370* (LOJA, QCNE); Parque Nacional Podocarpus, rd. Loja–Zamora, E of Cerro Yanacocha, 03°59′S, 79°07′W, 2550–2650 m, 26 Nov. 1988, *J. E. Madsen 75570* (AAU, QCA); Parque Nacional Podocarpus, above Cajanuma, trail from Centro de Información toward Lagunas de Compadre, 04°05′S, 79°10′W, 2900–3050 m, 16 Jan. 1989, *J. E. Madsen 85519* (AAU, QCA); Parque Nacional Podocarpus, above Nudo de Cajanuma, trail to Mirador, 04°05′S, 79°10′W, 2900–3000 m, 23 Feb. 1989, *J. E. Madsen 85821* (AAU, QCA, QCNE); Parque Nacional Podocarpus, E of Nudo de Cajanuma, N of Centro de Información, 04°05′S, 79°10′W, 2900 m, 8 Apr. 1989, *J. E. Madsen 85936* (AAU, QCA, QCNE), 16 Sep. 1989, *J. E. Madsen 86161* (AAU, QCA); rd. Yangana–Valladolid, Km. 12.1, 04°24′S, 79°09′W, 2240 m, 1 June 2001, *H. Vargas 4108*, *4109* (MO, QCNE); Km. 11, Finca del Dr. David Espinoza, 03°59′S, 79°09′W, 2590 m, 5 June 2001, *H. Vargas 4126* (MO, QCNE). **Zamora-Chinchipe:** Rd. Loja–Zamora, 2900 m, 12 Feb. 1985, *G. Harling & L. Andersson 21995* (GB); Estación San Francisco, rd. Loja–Zamora, Km. 30, 03°58′S, 79°04′W, 2230 m, 21 Oct. 2000, *J. Homeier 557* (MO, QCNE); rd. Yangana–Zumba, Km. 18, 2520 m, s.d., *J. Jaramillo 8685* (F, GB, NY); 14.3–25.3 km E of Loja, 03°58′S, 79°06′W, 2200–2745 m, 23 Apr. 1992, *J. L. Luteyn & K. Romoleroux 14547* (QCA); Parque Nacional Podocarpus, rd. Loja–Zamora, 03°58′S, 79°07′W, 2750–2950 m, 25 Dec. 1988, *J. E. Madsen & L. Elleman 75986* (AAU, QCNE); limit of Parque Nacional Podocarpus, 03°58′S, 79°07′W, 2900 m, 8 Jan. 1989, *J. E. Madsen 85498* (AAU, QCA, QCNE); Parque Nacional Podocarpus, rd. Yangana–Valladolid, Km. 21, 04°28′S, 79°09′W, 2700 m, 10 Nov. 1989, *J. E. Madsen 86409* (LOJA); limit of Parque Nacional Podocarpus, new rd. Loja–Zamora, E of the pass, 03°58′S, 79°07′W, 2500–3000 m, 25 Mar. 1990, *J. E. Madsen 87078* (AAU, QCA); Parque Nacional Podocarpus, E of the pass, 03°59′S, 79°09′W, 2800–2900 m, 1 Mar. 1985, *B. Øllgaard et al. 58472* (AAU, QCA); Parque Nacional Podocarpus, rd. Yangana–Valladolid, S of the pass (Nudo de Sabanilla), 04°27′S, 78°08′W, 2700 m, 14 Feb. 1989, *B. Øllgaard & J. E. Madsen 90557* (AAU); La Esmeralda, Cooperativa San Francisco de Numbala Alto, 2300 m, 04°22′S, 79°03′W, Jan. 1995, *W. Palacios 13107* (MO, QCNE), *13128* (MO, QCNE). PERU. **Amazonas:** Bongará, along rd. betw. Moyobamba & Chachapoyas, Distr. Pomacocha, vic. of Km. marker 339, E end of lago Pomacocha, 05°47′S, 77°54′W, 2250 m, 13 Apr. 1984, *T. B. Croat 58245* (MO); Bongará, path Pomacochas–Yambrasbamba, 2200–2300 m, 18 Aug. 1963, *R. Ferreyra 15249* (MO); Bongará, Balsapata, E of Pomacocha, 05°45′S, 77°50′W, 9 Feb. 1984, *A. H. Gentry & D. N. Smith 45210* (MO).

2. Viburnum stipitatum H. Vargas, sp. nov. TYPE: Ecuador. Loja: Sosoranga, rd. Sosoranga–Utuana, Km. 5.9, Villa Nueva, 1930 m, 4 June 2001, *H. Vargas 4121* (holotype, QCNE!; isotype, MO!). Figures 2B, 3.

Diagnosis. *Viburnum stipitatum* H. Vargas is distinguished from all Ecuadorian species of *Viburnum* L. except *V. obtectum* H. Vargas by having glandular teeth irregularly distributed along the whole margin of the leaf (vs. only along the apical or basal half); it differs from *V. obtectum* in having an abaxial leaf surface less densely pubescent, with the surface visible, stellate trichomes stalked to 0.2 mm (vs. sessile or occasionally shortly stalked to 0.1 mm), with branches 0.3–0.6 (–0.7) mm (vs. 0.2–0.4[–0.5] mm); medial abaxial cuticular surface of leaf lamina with striate periclinal walls without waxes (vs. undulate anticlinal waxed walls); smaller floral bracts, 1.2–2.5 mm (vs. 2–3.5[–4.2] mm); and fruit ovoid to broadly ellipsoid (vs. ellipsoid to spheroid).

Trees or shrubs (1.2–)7–12 m tall, DBH 2.5–12.7 cm; twigs 3–5 mm diam., indument white-cream, densely pubescent when young; internodes (2.5–)4–5.7(–8) cm; vegetative bud scales 2 pairs, sparsely to densely pubescent. Leaves decussate, rarely whorled; petiole 0.7–2 cm, densely pubescent; lamina (5.5–)8–12.3 (–16.2) × 3.7–7(–11) cm, elliptic, ovate, or broadly ovate, occasionally obovate, chartaceous or coriaceous; base obtuse to rounded; apex acute to abruptly acuminate; margin serrate with glandular teeth 4 to 15(to 22), irregularly distributed along whole margin, ciliate; adaxial surface sparsely pubescent, trichomes sessile or stalked stellate, medial surface with striate periclinal walls without waxes; abaxial surface pubescent, trichomes stalked stellate, stalk 0.2 mm, trichome branches 0.3–0.6(–0.7) mm; midrib pubescent, immersed above, prominent below; secondary veins semicraspedodromous, occasionally ending in the teeth

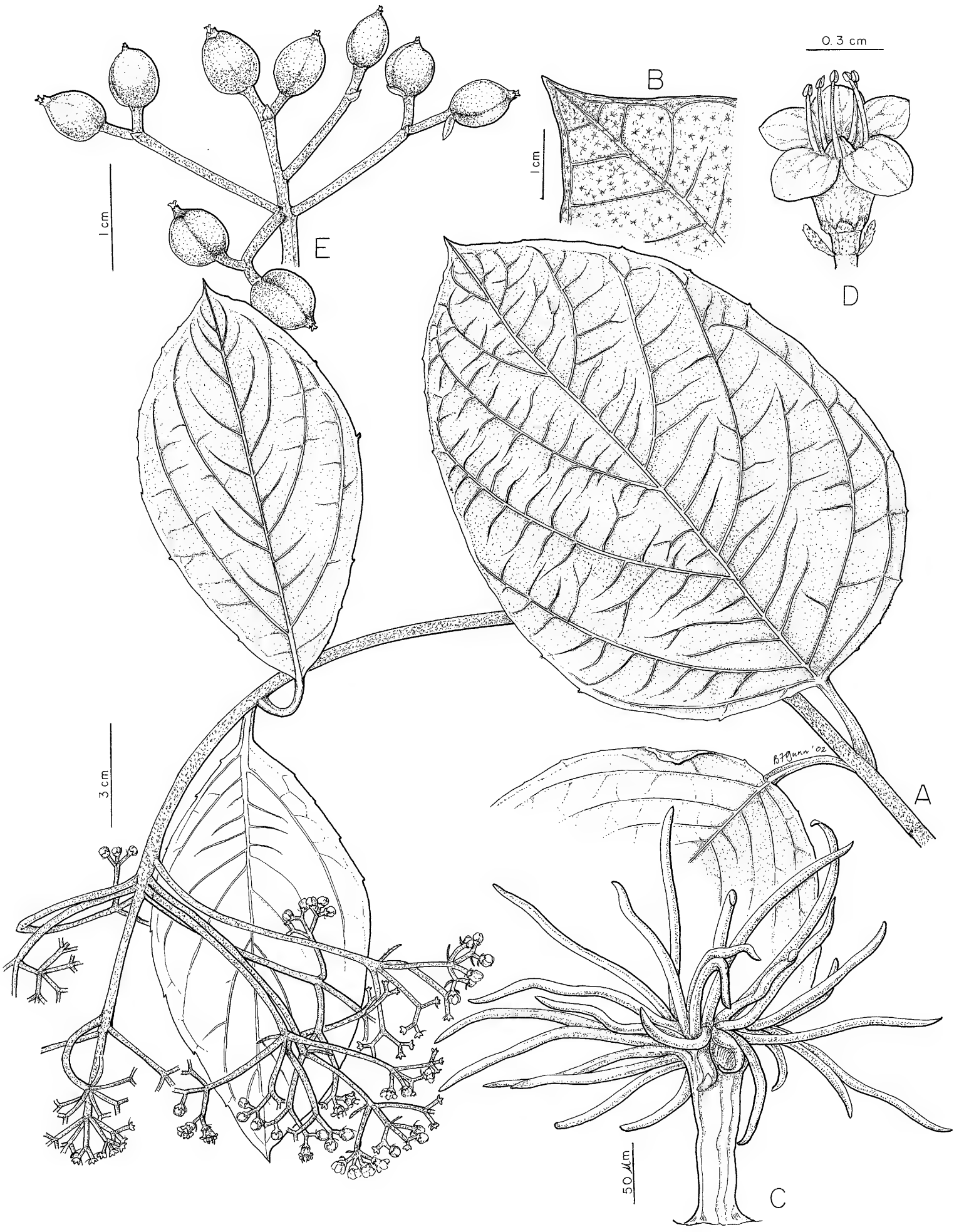

Figure 3. *Viburnum stipitatum* H. Vargas. —A. Flowering branch. —B. Pubescent abaxial leaf surface. —C. Stalked stellate trichome. —D. Flower. —E. Fruits. A–D drawn from *Øllgaard et al. 74776* (AAU); E drawn from *Jørgensen 2306* (QCNE).

toward the apical part, 4 to 6 pairs. Inflorescences terminal, umbellate or subumbellate, (1.8–)4–6 (–8.6) × 3.5–10.1(–13) cm, densely pubescent; peduncle absent to 7.1 cm; primary rays 6 to 8, (0.7–)1.4–4.2 (–5.9) cm, 0.8–1.8 mm diam.; primary bracts up to 9 mm; secondary rays 0.5–1.9(–2.7) cm; secondary bracts 2–7 mm; tertiary rays 0.3–0.7(–1.3) cm; tertiary bracts 2–3 mm; flowers 1 to 3(or 4) per ray, pedicel to 3.5 mm; floral bract 1.2–2.5 mm; bracteoles 0.5–2.3 mm. Sepals 0.5–1.2 mm, triangular, erect or spreading, adaxially sparsely pubescent with trichomes simple or sessile stellate, abaxially glabrous, margin

crenate, ciliate; receptacle 1.2–1.8 mm, sparsely to densely pubescent; petals 2.7–3.8 mm, white, abaxially glabrous to sparsely pubescent with trichomes simple and furcate, adaxially mostly glabrous to sparsely pubescent; filaments 3.1–3.7(–5) mm, anthers 0.9–1.4 mm; style glabrous to rarely sparsely pubescent, stigma glabrous, maroon, 3-lobed. Fruits black, ovoid to broadly ellipsoid, 6–8 × 4–7 mm, sparsely pubescent; endocarp 5.6–7.2 × 3.5–5.5 mm, groove undivided or Y-shaped, 1.3–2.3 mm wide, 0.8–1.3 mm deep; seed 5.1–6 × 3–4.9 mm.

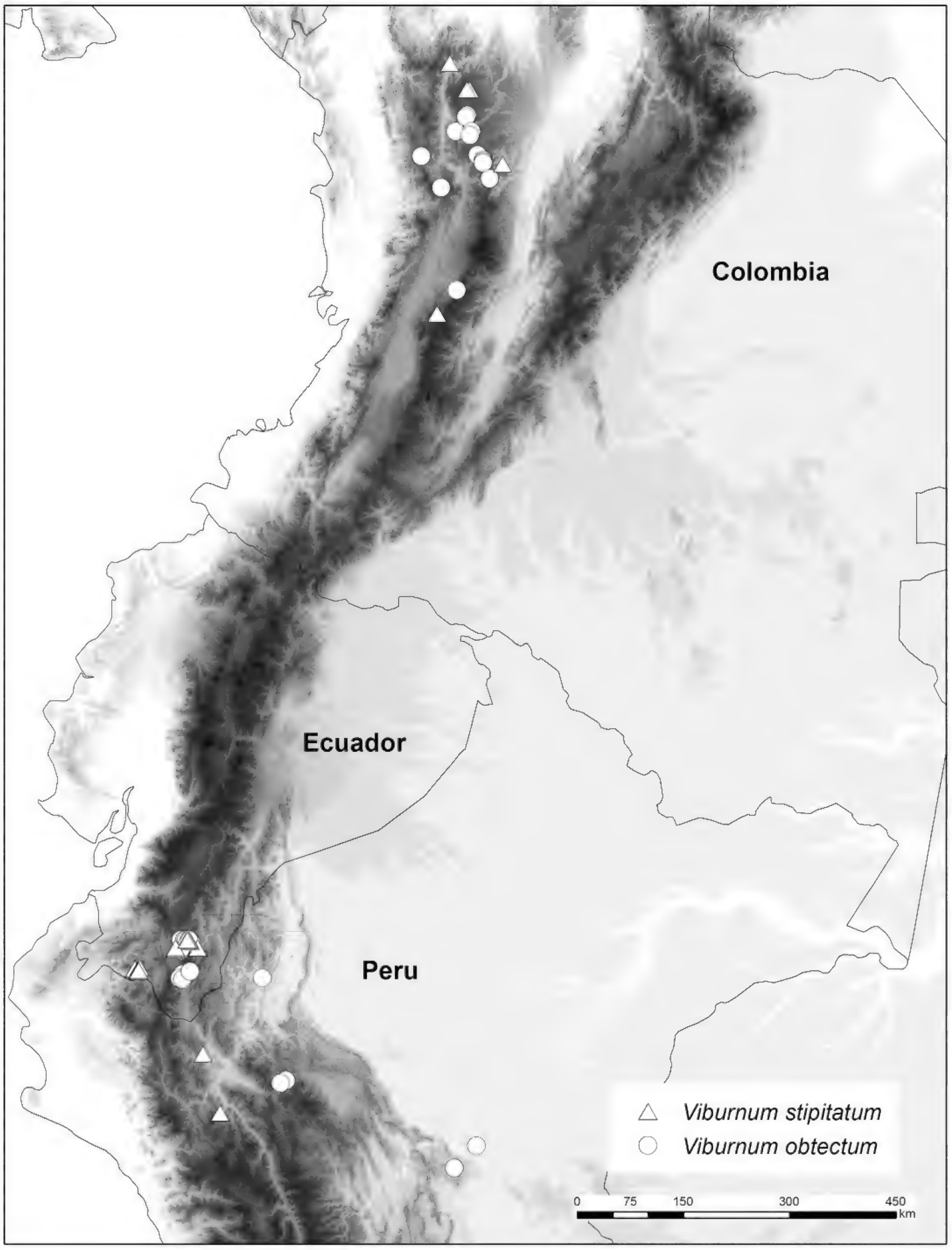

Figure 4. Distribution map of *Viburnum obtectum* H. Vargas and *V. stipitatum* H. Vargas in the tropical Andes.

Distribution. *Viburnum stipitatum* is found in the tropical Andes: in Colombia, in the central and northwestern part in the departments of Antioquia and Valle del Cauca; in Ecuador, in the southern part of the western and eastern cordilleras, in the provinces of Loja and Zamora-Chinchipe; and in northwestern Peru, in the departments of Cajamarca and San Martín (Fig. 4). Individuals have been collected from shrubby and primary vegetation in wet montane forest on volcanic soils at elevations of 1000–3020 m.

Etymology. The specific epithet refers to the stipitate trichomes.

Discussion. *Viburnum stipitatum* is presumed to be closely related to *V. obtectum* based on its general appearance and glandular teeth irregularly distributed along the whole margin of the leaf. However, *V. stipitatum* is easily distinguished by its long-stalked stellate trichomes on the abaxial leaf surface that are less dense and have a forest-like appearance, with stalks 0.2 mm long and branches 0.3–0.6(–0.7) mm long; additionally, the floral bracts are 1.2–2.5 mm long (vs. 2–3.5[–4.2] mm long in *V. obtectum*), and fruit shape varies from ovoid to broadly ellipsoid rather than ellipsoid to spheroid. It is distinguished from all other Ecuadorian species of *Viburnum* by the distribution of the glandular teeth along the whole margin (vs. the basal half or apical half) and by the additional characters of those species mentioned above. A key to the Ecuadorian species is provided below; though *V. obtectum* and *V. stipitatum* also occur in Colombia and Peru, compilation of updated keys to the species of those countries is outside the scope of the present work.

Paratypes. COLOMBIA. **Antioquia:** Yarumal, Llanos de Cuivá, 2790 m, 3 Aug. 1986, *P. Acevedo-Rodríguez et al. 1376* (MO); Ituango, El Retiro, 07°10′N, 75°45′W, 2570 m, 24 Feb. 1993, *H. Cuadros 4911* (MO); San Luis, Vereda La Josefina, Fina Palmira, 05°53′N, 75°05′W, 850 m, 16 Mar. 1997, *R. Fonnegra et al. 6353* (MO); Santa Rosa de Osos, Llanos de Cuivá, Km. 24 N of Santa Rosa de Osos, 06°50′N, 75°30′W, 2625 m, 27 May 1984, *J. Luteyn et al. 10793* (MO); Santa Rosa de Osos, Km. 5–12 of rd. from Llanos de Cuivá to San Andrés, 06°50′N, 75°32′W, 2680–2730 m, 10 May 1988, *J. L. Zarucchi & J. Betancur 6404* (MO). **Valle del Cauca:** Cordillera Central, vertiente occidental, Cabeceras del río Palo, Quebrada de Santo Domingo, 2950–3150 m, 13 Dec. 1944, *J. Cuatrecasas 19268* (MO); Tulua, Corregimiento Santa Lucia, Hacienda La Cascada, Cerro del Japón, Cordillera Central de los Andes, 03°59′N, 75°55′W, 2900 m, 3 Nov. 1987, *W. Devia & F. Prado 2001* (MO). ECUADOR. **Loja:** Cerro Sozoranga, rd. Colaisaca–Utuana, Km. 0.5, 04°20′S, 79°41′W, 2370–2490 m, 25 Apr. 1994, *P. M. Jørgensen et al. 583* (MO, QCNE); rd. Cariamanga–Utuana, Km. 29.5, 04°21′S, 79°42′W, 2610 m, 29 Apr. 1994, *P. M. Jørgensen et al. 649* (LOJA, NY, QCA, QCNE); Cerro El Tambo, rd. Loja–Las Palmas, just S of Cerro Villonaco, 04°04′S, 79°14′W, 2570–3020 m, 30 Nov. 1994, *P. M. Jørgensen et al. 1084* (LOJA, NY, QCNE), 23 July 1990, *P. M. Jørgensen et al. 92086*, *92096* (AAU, QCA, QCNE); Utuana, 04°22′S, 79°42′W, 2500 m, 23 Sep. 1989, *M. Munday & G. Maldonado 59* (QCA, QCNE); La Palma, 2850 m, 27 Dec. 1988, *M. Rios 224* (AAU, QCA); rd. Sozoranga–Cariamanga, Las Berbenas, 2200 m, 28 Feb. 1988, *C. Ulloa 664* (AAU, GB, QCA, S); Cerro Uritusinga, rd. La Palma, Km. 18–20, 04°05′S, 79°14′W, 2910–3000 m, rd. Sozoranga–Utuana, Km. 5.9, 04°20′S, 79°45′W, 1930 m, 4 June 2001, *H. Vargas 4120*, *4121* (MO, QCNE); Km. 6.7, 04°20′S, 79°45′W, 2000 m, 4 June 2001, *H. Vargas 4122*, *4123* (MO, QCNE); Km. 13.7, 04°20′S, 79°43′W, 2400 m, 4 June 2001, *H. Vargas 4124*, *4125* (MO, QCNE). **Zamora-Chinchipe:** Estación Científica San Francisco, 03°58′S, 79°05′W, 1900 m, 16 Oct. 1996, *R. W. Bussmann & S. Lange s.n.* (QCNE); Podocarpus Natl. Park, near El Tambo, 40 km NW of Zamora on rd. to Loja, 03°58′S, 79°07′W, 2210 m, 13 July 1993, *A. Gentry 79946* (QCNE); 03°58′S, 79°04′W, 1850 m, 24 Mar. 1999, *J. Homeier 7*, *8* (LOJA); rd. Loja-Zamora, Km. 24, 03°59′S, 79°06′W, 2100–2190 m, 11 Nov. 2000, *P. M. Jørgensen et al. 2306* (MO, QCNE); Planta Eléctrica San Ramón, 18 km E of Loja, near Sabanilla, 03°59′S, 79°03′W, 1800 m, 3 Sep. 1975, *E. L. Little et al. 202* (US); 30 km E of Loja, 03°59′S, 79°04′W, 2100 m, 20 Apr. 2000, *D. Neill et al. 12608* (LOJA, MO); N of Zamora, 04°04′S, 78°57′W, 1000–1200 m, 13 June 1988, *B. Øllgaard et al. 74776* (AAU); Palanda, 10 May 1984, *F. Vivar & B. Merino 2090* (AAU). PERU. **Cajamarca:** La Palma, 10 km NW de Chirinos, 05°25′S, 78°53′W, 1780 m, 4 Feb. 1988, *A. Gentry et al. 61149* (MO); Cutervo, lower edge of Cutervo Natl. Park, 10–15 km N of San Andrés de Cutervo, 06°10′S, 78°40′W, 2200–2250 m, 11 Feb. 1988, *A. Gentry et al. 61487* (MO); Cutervo, Dpto. San Andrés de Cutervo, rte. of the las Grutas, N of San Andrés, 2200 m, 25 June 1989, *R. Sánchez 4876* (MO); Cutervo, betw. Socota y Pucarilla, 8 km of Socota, 2300 m, 21 June 1992, *R. Sánchez 6240* (MO); Taen, Valley of the Tabaconas River, 1600 m, May 1912, *A. Weberbauer 6241* (MO, S). **San Martin:** Mariscal Caceres, Río Abiseo Natl. Park, Río Montecristo watershed, forest near Papayas campsite, 2700 m, 19 Aug. 1986, *K. Young 4289* (MO).

Key to *Viburnum* Species in Ecuador

1. Glandular teeth irregularly distributed along whole leaf margin.
   2. Leaf blade abaxially very densely pubescent, the surface invisible, stellate trichomes sessile or shortly stalked to 0.1 mm long, branches 0.2–0.4(–0.5) mm long . . . . . *V. obtectum* H. Vargas
   2′. Leaf blade abaxially pubescent, the surface visible, stellate trichomes longer-stalked to 0.2 mm long, branches 0.3–0.6(–0.7) mm long . . . . . *V. stipitatum* H. Vargas
1′. Glandular teeth distributed along apical half or basal half of leaf margin.
   3. Glandular teeth distributed along basal half of leaf margin.

4. Petiole with glands; leaves decussate; vegetative bud scales 2 pairs; inflorescence up to 12.5 × 18 cm; pedicel glabrous immediately below bracteoles; restricted to the eastern cordillera, 750–2400 m ..... *V. toronis* Killip & A. C. Sm.

4′. Petiole eglandular; leaves whorled (rarely decussate); vegetative bud scales 3(or 4) pairs; inflorescence up to 5.6 × 9.2 cm; pedicel pubescent; widespread, 1010–3800 m..... *V. triphyllum* Benth.

3′. Glandular teeth distributed along apical half of leaf margin.

5. Abaxial surface of leaf blade sparsely pubescent.

6. Leaves decussate; inflorescence (3.7–)5–10.5(–15.5) cm diam., primary rays 6 to 9, supporting bract 1.3–2.2 mm long; petals 2.6–3.5 mm long; endemic to El Oro..... *V. divaricatum* Benth.

6′. Leaves whorled (rarely decussate); inflorescence (2.3–)3.6–7.5(–11.5) cm diam., primary rays 6 or 7(or 8), supporting bract 1.3–4 mm long; petals 3.1–4.8(–5.2) mm long; widespread..... *V. hallii* (Oerst.) Killip & A. C. Sm.

5′. Abaxial surface of leaf blade pubescent to densely pubescent.

7. Leaf blade abaxially rufous, indumentum equally distributed, trichomes sessile and stalked stellate; vegetative bud scales 2 pairs; petiole 0.7–1.5(–1.9) cm long; receptacle pubescent to densely pubescent; widespread..... *V. pichinchense* Benth.

7′. Leaf blade abaxially yellow to brown, notably densely pubescent on each side of the veins, trichomes simple, furcate, and sessile stellate; vegetative bud scales 3 pairs; petiole 0.5–0.8(–1.1) cm long; receptacle glabrous (sparsely pubescent); Carchi..... *V. jamesonii* (Oerst.) Killip & A. C. Sm.

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A New Species of the Genus *Lagochilus* (Lamiaceae) from Khorassan–Kopet Dagh Floristic Province

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Abstract. A new species of the genus *Lagochilus* Bunge ex Benth. from Iran and Turkmenistan, *L. khorassanicus* Zeraatkar, F. Ghahrem. & Joharchi, is described and illustrated here. The new species most closely resembles *L. schugnanicus* Knorring of Afghanistan, Pakistan, and the mountain ranges of Central Asia. It is easily differentiated from other species of the *Flora Iranica* area by the bracteole morphology and number of flowers in verticillasters. A key to the species of that area and a distribution map of the new species and its relatives are provided.

Key words: Iran, Irano–Turanian region, Khorassan–Kopet Dagh floristic province, *Lagochilus*, Lamiaceae, Turkmenistan.

The genus *Lagochilus* Bunge ex Benth. (Bentham, 1834) is nearly restricted to the Irano–Turanian region and represented by ca. 40 species distributed over Central Asia, Afghanistan, northwestern Pakistan, Iran, and northwestern China (Mabberley, 2008). Due to inconsistent treatment in different floristic accounts and lack of a consistent monographic view of species across their range, some of the species differ in only minor characteristics, and there is no clear-cut delimitation among them. In carrying out a review of *Lagochilus* across its entire range, we identified specimens from Khorassan–Kopet Dagh floristic province that did not match any existing species (Knorring, 1954; Rechinger, 1982; Jamzad, 1988; Hedge, 1990; Jamzad, 2012; Dehshiri & Mozaffarian, 2013). These are described as a new species here.

Herbarium specimens were carefully compared with *Lagochilus* specimens at FAR, FUMH, LE, P, T, W, and the Shiraz University Herbarium along with high-resolution images of specimens from B, K, W, and PE. To examine trichome morphology using SEM, a small piece of abaxial corolla apex was mounted directly on a stub fitted with adhesive tape and coated with a gold layer. The specimen stub was imaged with a Hitachi SU3500 Scanning Electron Microscope (Hitachi High-Technologies Corp., Tokyo, Japan) at accelerating potential voltage of 1.5 kV and 60× magnification in the central laboratory of Shahid Beheshti University. In addition, stereomicroscopic micrographs of bracteoles were taken under a stereomicroscope (Zeiss Stemi SV8; Zeiss, Oberkochen, Germany).

Lagochilus khorassanicus Zeraatkar, F. Ghahrem. & Joharchi, sp. nov. TYPE: Iran. North Khorassan: Dargaz, Tandureh Natl. Park, Chehelmir, 1035–1200 m, 16 June 2004, *F. Memariani & H. Zangooei 35558* (holotype, FUMH!, isotypes, FAR!, T!, Shiraz University herbarium!). Figures 1–3.

Diagnosis. *Lagochilus khorassanicus* Zeraatkar, F. Ghahrem. & Joharchi is closely related to *L. schugnanicus* Knorring, differing by calyx teeth unequal (vs. subequal to equal), often narrowly oblong (vs. broadly oblong), 7–23 × 1.8–2.5(–3) mm (vs. 7–18 × 5–7 mm), and acuminate or rarely subacute at apex (vs. rounded to obtuse); leaf segments 0.1–1(–2) mm wide and revolute (vs. 1.5–5 mm wide, flat or slightly revolute); corolla ca. 22 mm (vs. 25–30 mm); and bracts substipitate (vs. sessile).

Perennial herbs. Stems diffuse, white, 20–45 cm high, numerous, simple or branched, erect or slightly curved, basal part glabrous, apical part covered with short, simple, 2- to 4(to 5)-jointed long hairs and sessile capitate glands; nodes usually densely pubescent with 2- to 4(to 5)-jointed long hairs. Leaves usually clustered at axillary nodes, opposite in verticillasters, 4 per node;

Ferdowsi University of Mashhad Herbarium
FUMH
0 1 2 3 4 5 6 7 8 9 10
Ferdowsi University of Mashhad, Herbarium (FUMH)
Lagochilus khorassanicus sp. nov
Conf./Rev.: A. Zeraatkar 05.05.2016
FLORA OF KHORASAN (IRAN)
MASHHAD UNIVERSITY HERBARIUM
Name /
Common Name /
Locality /
Date /
Alt / 1035–1200 m No 35558
Collector / Memariani & Zangooei
Identified by / Joharchi 2005
Remarks /

Figure 1. Holotype of *Lagochilus khorassanicus* Zeraatkar, F. Ghahrem. & Joharchi (*F. Memariani & H. Zangooei 35558*, FUMH). Photo by M. R. Joharchi.

leaf blade rhomboid, deeply dissected, 1- to 2-pinnate, often bipinnate, 18–32 × 10–30 mm; segments linear-oblong with revolute margins, acuminate or rarely subacute, 1–8 × 0.1–1 mm (to 2 mm wide in lowermost), apex of leaf segments of apicalmost leaves rarely short-spinescent with spine 0.25–0.5 mm; both surfaces eglandular or moderately-sparsely covered with sessile capitate glands on both sides; margins adpressed, ciliolate; petiole 0–2 mm in inner leaves, outer leaves sessile. Verticillasters 4- to 6-flowered, often compact. Bracteoles spinescent, 2(4) compound-bifurcated pairs, 0.5–22 mm, unequal, thin, substipitate, sessile in lower

Figure 2. *Lagochilus khorassanicus* Zeraatkar, F. Ghahrem. & Joharchi. —A. Habit. —B. Close-up of flower. Photos by A. Zeraatkar from Mashhad–Kalat rd. (May 2016).

part of stem, obviously twice-trifurcated in verticillasters and near them, the middle branch strongly reduced and bracts superficially twice-bifurcated in lower part of stem; stalk (0–)1–1.7 mm, tomentose, glabrous at apex, covered with short, simple trichomes; basalmost part of stem without bracteoles. Calyx 20–30 mm, campanulate, at least 1.5(to 2.5) times as long as tube, 5-toothed or rarely 4-toothed; tube 6–10 × 2–3 mm, sometimes bearing sparse 2- to 4(to 5)-jointed trichomes 40–50 μm; teeth narrowly oblong, unequal, 7–23 × 1.8–2.5(–3) mm, apex acuminate or rarely subacute terminating in a prickle 0.5–1.2 mm; both surfaces covered with sessile capitate glands and short, simple trichomes on tube and nerves as well as at margin. Corolla ca. 22 mm, whitish, with distinct purple veins, cream to pale brown when dried; upper lip emarginate, with 2 equal teeth, densely covered with silky hairs abaxially, adaxially glabrous; lower lip trilobate, middle lobe notched, obcordate, lateral lobes linear-lanceolate, abaxially sparsely pubescent, adaxially glabrous. Posterior stamens 15–18 mm, anterior 13–16 mm. Nutlets smooth, 3 × 0.5 mm.

Phenology. *Lagochilus khorassanicus* was observed to flower from mid-May to mid-June and to fruit from late June to mid-July.

Distribution and ecology. *Lagochilus khorassanicus* is very likely restricted to Khorassan–Kopet Dagh floristic province. It is relatively common in the cited area and shows a geographically distinct distribution from the adjacent species, i.e., *L. aucheri* Boiss., *L. cabulicus* Benth., and *L. balchanicus* Czerniak., which occur in the southeast, south to west, and northwest of the area, respectively (Fig. 4). Therefore, the novelty is isolated geographically from other species. The new species grows together with several hemicryptophytes such as *Matthiola farinosa* Bunge ex Boiss., *M. afghanica* Rech. f. & Köie, *Hymenocrater sessilifolius* Benth., *Hedysarum monophyllum* Boriss., and *Stachys lavandulifolia* Vahl.

IUCN Red List category. GeoCAT (<http://geocat.kew.org/>; Bachman et al., 2011), extent of occurrence (EOO) was calculated to be 31,123 km^2 and area of occupancy (AOO) 20,480 km^2 based on a user-defined cell width of 32 km. *Lagochilus khorassanicus* has been collected from several localities in North Khorassan and Razavi Khorassan Provinces in Iran, and also from southern Turkmenistan (those specimens were mentioned by Rechinger [1982] and Knorring [1954] as *L. cabulicus*), but is restricted to a small part of Khorassan–Kopet Dagh floristic province (Fig. 4). Thus a preliminary assessment of Near Threatened (NT), based on the criteria of IUCN (2001), is indicated.

Etymology. The species epithet refers to Khorassan Province in northeastern Iran.

Taxonomic notes. *Lagochilus khorassanicus* is most similar to *L. schugnanicus* in having 4- to 6-flowered verticillasters and twice-trifurcated bracts but differs from the latter by the characters given in Table 1 (see also Fig. 3A–E). *Lagochilus schugnanicus* occurs in northwestern Pakistan (the specimens mentioned as *L. cabulicus* by Hedge [1990]; see the identification key), northeastern Afghanistan, Pamir–Alay, and Tien Shan (Rechinger, 1982). Additionally, the new species is readily distinguished from *L. balchanicus* (not included in the *Flora Iranica* area [Rechinger, 1982]) and seven other Iranian species of *Lagochilus* by its 4- to 6-flowered (vs. 2-flowered) verticillasters and twice-trifurcated (vs. twice-bifurcated) bracts (Fig. 3). A key to the species of the *Flora Iranica* area is provided below.

Paratypes. IRAN. **North Khorassan:** Bojnurd, Rakhtian to Hesar, 4 July 1993, *G. Faghihnia & H. Zangooei 23549* (FUMH); Faruj, beginning of Khosraviyeh, 60 km to Quchan, 1550 m, 18 June 1981, *S. J. Ghorashi 1054G* (FUMH); Bojnurd, Gifan, 2 km Ghezelghan to Ayub, 1 July 1981, *S. J. Ghorashi 1147G* (FUMH); Bojnurd, betw. Goynek & Baghleq, 11 June 2001, *M. R. Joharchi 33711* (FUMH); Esfarayen, NW Nasrabad, 1500 m, 16 June 2006, *M. R. Joharchi 34756* (FUMH); Shirvan, Gelyan to Estarkhi, 9 June 1983, *M. R. Joharchi & H. Zangooei*

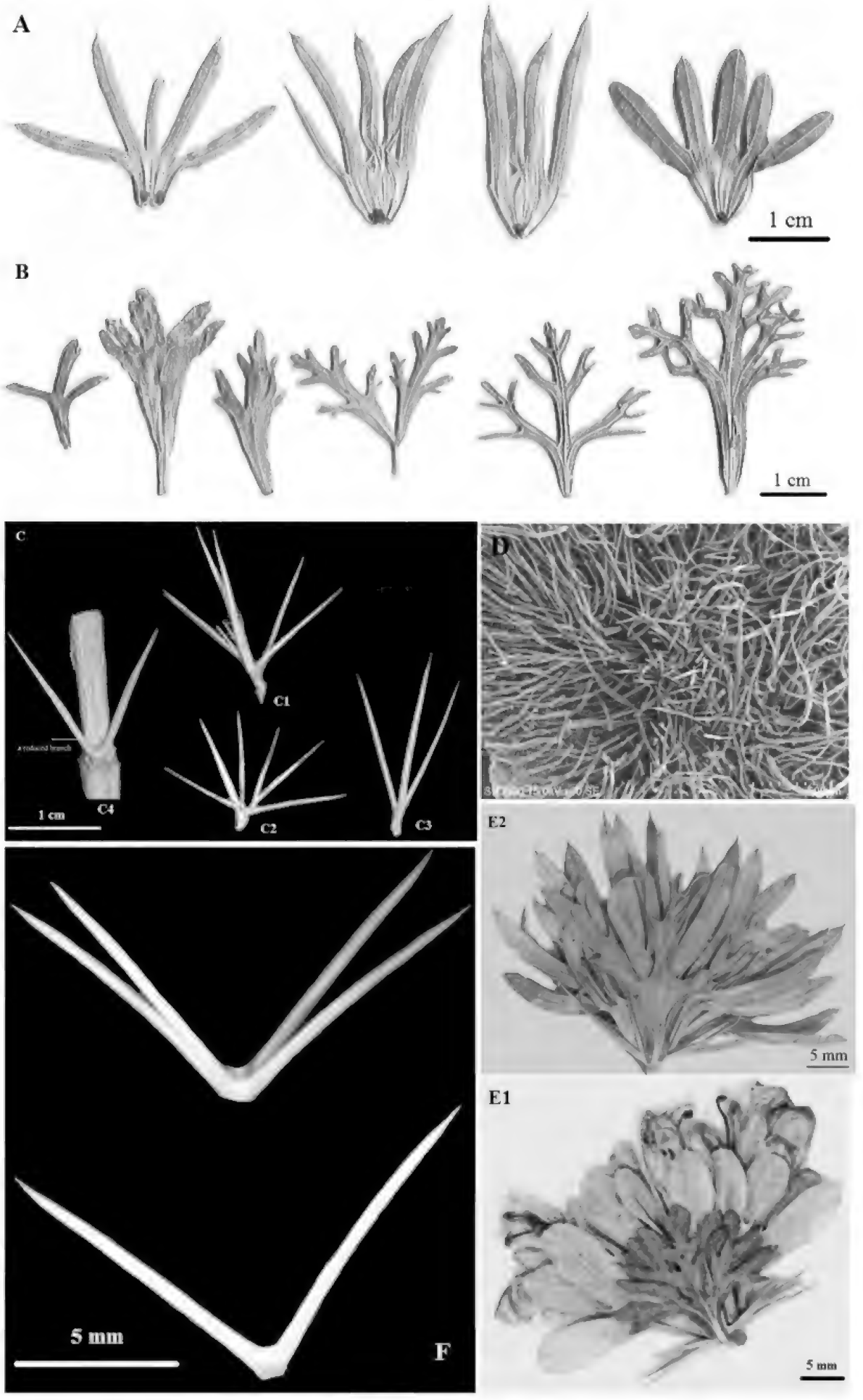

Figure 3. A–D. *Lagochilus khorassanicus* Zeraatkar, F. Ghahrem. & Joharchi. —A. Calyx. —B. Leaves. —C. Stereomicroscopic micrographs of bract diversity. —C1–C3. Bracteoles from upper part of stem. —C4. Bracteole from lower part of stem with middle branch strongly reduced. —D. Long uniseriate-unicellular trichomes on corolla apex. E. Close-up of verticillaster. —E1. *Lagochilus schugnanicus* Knorring, *O. Anders* (KUFS 020724). —E2. *Lagochilus khorassanicus*, *Memariani & Zangooei 35558* (T, isotype). —F. Bracteoles in *L. aucheri* Boiss. Photos by A. Zeraatkar.

10422 (FUMH); Bojnurd, 11 km Pakotal to Assadli, 37°16′47.10″N, 57°30′51.60″E, 16 June 2008, *M. R. Joharchi & H. Zangooei 40828* (FUMH); Bojnurd, Beshghardash, 1050 m, 14 May 1988, *M. R. Joharchi & H. Zangooei 16530* (FUMH); Bojnurd, Saluk, Zow-e Garivan, after Firouzeh, 1 June 1998, *S. S. Hojjat & H. Zangooei 31215* (FUMH); Bojnurd, Qorkhud protected area, 37°23′28.10″N, 56°26′27.40″E, 1540–1600 m, 7 June 2010, *F. Memariani & A. A. Arjmandi 43826* (FUMH); Bojnurd, 4 km SE Raz to Pirboz, 37°53′49.60″N, 57° 8′28.10″E, 21 May 2008, *F. Memariani & H. Zangooei 40300* (FUMH); Bojnurd, Jargalan, 3 km Guynik to Goynek, 38°4′34.80″N, 56°58′51.60″E, 11 June 2008, *F. Memariani*

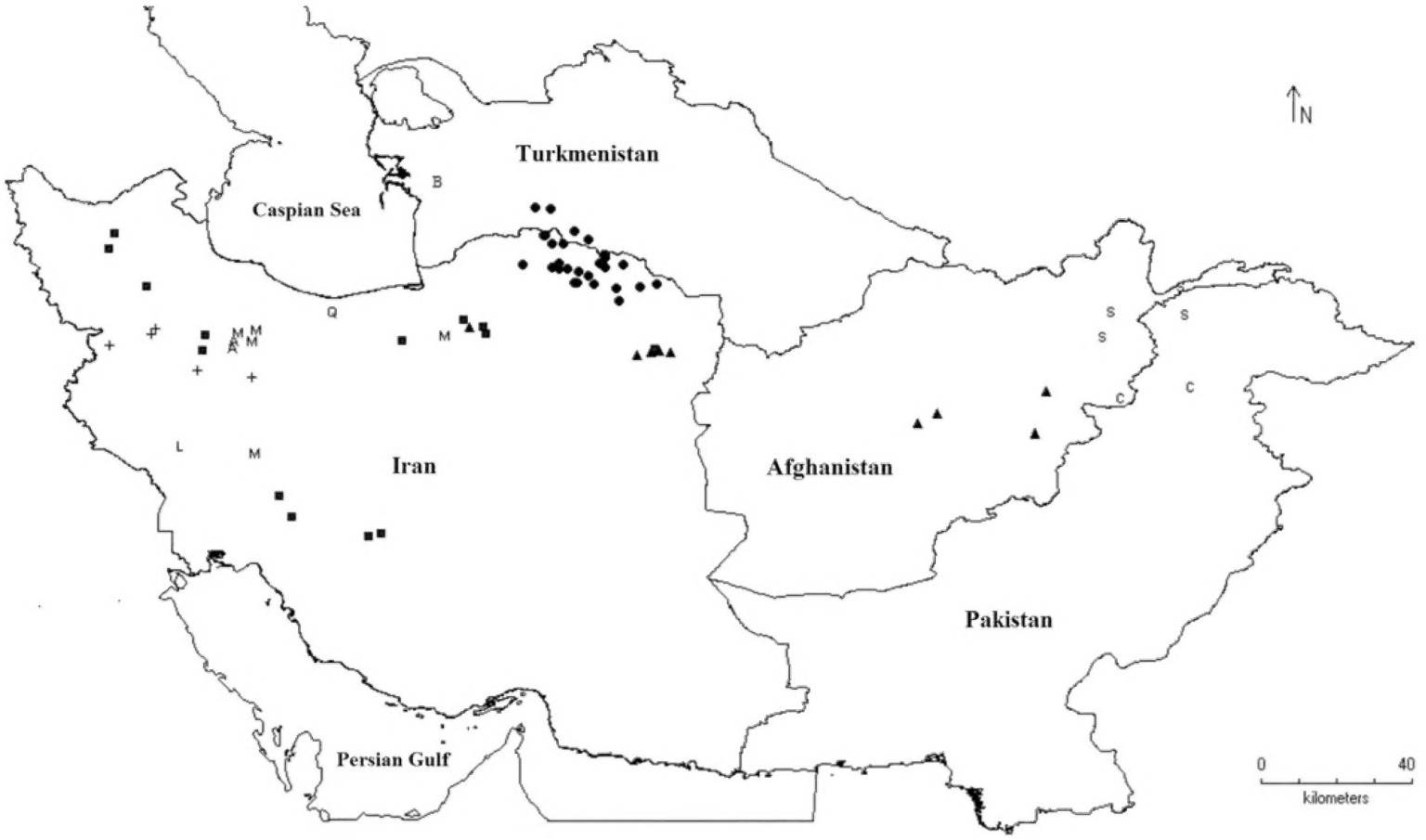

Figure 4. Distribution map of cited *Lagochilus* species: *L. khorassanicus* Zeraatkar, F. Ghahrem. & Joharchi (dot), *L. schugnanicus* Knorring (S), *L. aucheri* Boiss. (square), *L. cabulicus* Benth. (triangle), *L. lorestanicus* Dehshiri & Mozaff. (L), *L. macracanthus* Fisch. & C. A. Mey. (M), *L. lasiocalyx* (Stapf) Jamzad (cross), *L. balchanicus* Czerniak (B), *L. alutaceus* Bunge (A), *L. quadridentatus* Jamzad (Q), *L. cuneatus* Benth. (C).

& *H. Zangooei 40778* (FUMH); Faruj, 1.5 km S Koran Kordiyeh, 37°24′43.70″N, 58°16′18.70″E, 1507 m, 1 June 2009, *F. Memariani & H. Zangooei 42771* (FUMH); Sarigol Natl. Park, ca. 2 km W Qaleh Maran, 2103 m, 2 June 2009, *N. Rahchamani 6383* (T); S Sarigol Natl. Park, 36°56′2.00″N, 57°45′40.00″E, 1608 m, 3 June 2009, *N. Rahchamani 6473* (T); Shirvan, Borzeli village, 26 June 1995, *A. Rafeie & H. Zangooei 25997* (FUMH). **Razavi Khorassan:** Quchan, Rahvard to Assibolagh, 10 June 1998, *G. Faghihnia & H. Zangooei 31504* (FUMH); Quchan, N Bajgiran, Baba Aselmah, 1600 m, 15 July 1992, *G. Faghihnia & H. Zangooei 22243* (FUMH); Quchan, Dorbadam to Bajgiran, 30 km to Bajgiran, 1800 m, *G. Faghihnia & H. Zangooei 22214* (FUMH); Chenaran, beginning of Boqmech, E Radkan, 1750–1800 m, 20 May 1982, *S. J. Ghorashi 1719G* (FUMH); Quchan, rd. of Bardar–Bajgiran, S mtns. Bajgiran, 1700 m, 16 June 1981, *S. J. Ghorashi 796G* (FUMH); Quchan, Shoql abad, Pass Hessar Mtn., 1900 m, 12 June 1983, *M. R. Joharchi & H. Zangooei 10441* (FUMH); NW Neyshabur, Bar village, 36°31′19.06″N, 58°45′20.29″E, 2046 m, 7 May 2016, *A. Zeraatkar 16025* (FAR, T, Shiraz University herbarium); Mashhad, 125 km to Kalat from Mashhad, 9 June 2016, *A. Zeraatkar 16026* (FAR, T, Shiraz University herbarium). 100 km to Kalat from Mashhad, 1548 m, 9 May 2016, *A. Zeraatkar 16027* (T). TURKMENISTAN. **Kisil-Arwat:** Karakala in monte Sundsodagh, 18 May 1901, *P. Sintenis 1717* (K000929091, K000929090, as images). **Regio Transcaspica:** Aschabad: Suluklu (Saratowka), July 1900, *P. Sintenis 807* (P03834564, P03519714, B100277291, as images).

Key to the Species of *Lagochilus* in the *Flora Iranica* Area

1. Verticillasters 4- to 6-flowered, bracts twice-trifurcated...2
2. Shrubs, leaves simple.....*L. cuneatus* Benth.
2′. Perennial herbs, leaves pinnate 3
3. Leaves 1- to 2-pinnate, segments 0.1–1(–2) mm wide; bracts substipitate (sessile in lower part of stem); calyx teeth unequal, at least 1.5(to 2.5) times as long as tube, often narrowly oblong, 7–23 × 1.8–2.5(–3) mm, acuminate or rarely subacute at apex...*L. khorassanicus* Zeraatkar, F. Ghahrem. & Joharchi
3′. Leaves 2-pinnate, segments 1.5–5 mm wide; bracts sessile; calyx teeth equal (subequal), equal to or sometimes slightly shorter or longer than calyx tube, broadly oblong, 7–18 × 5–7 mm, obtuse or rounded at apex...*L. schugnanicus* Knorring
1′. Verticillasters 2-flowered, bracts twice-bifurcated.....4
4. Leaves simple; calyx teeth shorter than calyx tube, triangular-lanceolate.....*L. lorestanicus* Dehshiri & Mozaff.
4′. Leaves usually divided; calyx teeth longer or shorter than or equal to calyx tube, oblong or linear-lanceolate.....5
5. Calyx teeth linear-lanceolate, acute at apex; calyx tube always covered with stiff hairs...*L. lasiocalyx* (Stapf) Jamzad
5′. Calyx teeth oblong, acute or obtuse at apex; calyx tube glabrous or rarely with stiff hairs 6
6. Calyx teeth equal to or shorter than calyx tube 7
7. Leaves 15–25 mm; calyx teeth shorter than or equal to the length of tube.....*L. macracanthus* Fisch. & C. A. Mey.
7′. Leaves 7–13 mm; calyx teeth as long as calyx tube..... .....*L. alutaceus* Bunge
6′. Calyx teeth longer than calyx tube.....8
8. Calyx 10–22 mm, 5-toothed; calyx teeth 10–12 × 2 mm.... .....*L. cabulicus* Benth.
8′. Calyx 17–30 mm, 4-, 5-, or 4- and 5-toothed on the same plant; calyx teeth 11–20 × 2–5 mm.....9
9. Calyx 5-toothed (sometimes 4- and 5-toothed on the same plant); calyx teeth oblong, 2–3 mm wide, acute at apex..... .....*L. aucheri* Boiss.

Table 1. Diagnostic morphological characters of *Lagochilus khorassanicus* Zeraatkar, F. Ghahrem. & Joharchi and *L. schugnanicus* Knorring.

	L. khorassanicus	*L. schugnanicus*
Leaves	1- to 2-pinnate	2-pinnate
Leaf segments	0.1–1(–2) mm wide, revolute at margin throughout	1.5–5 mm wide, flat or slightly revolute
Leaf segment apex	acuminate or rarely subacute	rounded to obtuse
Bracts	substipitate (sessile in lower part of stem), stalk 1–1.7 mm	sessile
Calyx teeth shape	unequal, at least 1.5(to 2.5) times as long as tube, often narrowly oblong	equal (subequal); equal to or sometimes slightly shorter or longer than calyx tube, broadly oblong
Calyx teeth size	7–23 × 1.8–2.5(–3) mm	7–18 × 5–7 mm
Calyx teeth apex	acuminate or rarely subacute	obtuse or rounded
Corolla size	ca. 22 mm	25–30 mm
Long uniseriate-unicellular trichomes	2- to 4(to 5)-jointed	1- to 2-jointed
Distribution	Khorassan–Kopet Dagh floristic province	Central Asia

9′. Calyx 4-toothed (sometimes 4- and 5-toothed on the same plant); calyx teeth broadly oblong, 4–5 mm wide, rounded at apex.....*L. quadridentatus* Jamzad

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Cover illustrations. ***Top, left to right.*** *Gentianella empetroides* J. S. Pringle, plant; *Gentianella nephostelium* J. S. Pringle, plant; *Alectryon vitiensis* Buerki, Lowry, Munzinger & Callm., fruiting branch. ***Bottom, left to right.*** *Lepidium stephan-beckii* Al-Shehbaz, plant; *Viburnum obtectum* H. Vargas, flowering branch.